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INVESTIGATION OF STRIPPING OF VOLATILE ORGANIC CONTAMINANTS IN MUNICIPAL WASTEWATER TREATMENT SYSTEMS - PHASE 1

DECEMBER 1988

Environment Ontario

Jim Bradley
Minister

ISBN 0-7729-4720-1

INVESTIGATION OF STRIPPING OF VOLATILE ORGANIC CONTAMINANTS IN MUNICIPAL WASTEWATER TREATMENT SYSTEMS PHASE I

by

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Ontario Ministry of the Environment

DECEMBER 1988

ABSTRACT

A field sampling program was carried out at four Ontario municipal wastewater treatment plants to characterize the emissions of volatile organic contaminants (VOCs) to the atmosphere from aerated process vessels. Off-gas and wastewater samples were taken from aerated grit chambers and aeration basins at the four plants. Many of the VOCs on the MISA list of pollutants were observed to be emitted to the atmosphere from the treatment processes. For the four plants tested, the total VOC emission rates for the measured compounds ranged from approximately 1.5 to 75 g per thousand m^3 of wastewater treated. The maximum total VOC concentrations in the off-gases for the measured compounds ranged from approximately 300 to 6500 $\mu g/m^3$. The compounds observed at highest concentration levels in the off-gases were:

dichloromethane
toluene
1,1,1-trichloroethane
m,p-xylene
1,3,5-trimethylbenzene
3-ethyltoluene
4-ethyltoluene

A comprehensive literature review was conducted covering theoretical and experimental work related to volatilization of VOCs from water and wastewater systems. The measured VOC emissions were compared with the predictions of several mass transfer models. In general, the models appeared to predict higher off-gas VOC concentrations than measured. Most of the VOCs were found at off-gas concentrations below the predicted saturation level. Conservative predictions of VOC emissions can be obtained by assuming equilibrium between the off-gas and the wastewater, and that Henry's law applies.

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INVESTIGATION OF STRIPPING OF VOLATILE ORGANIC CONTAMINANTS IN MUNICIPAL WASTEWATER TREATMENT SYSTEMS

PHASE 1

1. INTRODUCTION

1.1 Project Background

Volatile organic compounds (VOCs) are consistently found in municipal wastewater treatment plant influents. These compounds are stripped from the wastewater during aeration and are perceived to constitute an environmental hazard. Theoretical models have been developed to predict the behaviour of VOCs in aerated process basins. These models have been tested in laboratory experiments, but not to a significant extent in full scale or pilot plant systems.

A comprehensive study of air stripping of VOCs in full scale and pilot plant systems is needed to assess the potential for release of volatile organics to the atmosphere and to evaluate the validity of theoretical, predictive models. In addition, it is necessary to know the fate of hazardous compounds entering municipal treatment plants in order to establish appropriate regulations concerning discharges to and from these plants. To make these determinations, the Ontario Ministry of the Environment (MOE) has carried out a wastewater and sludge sampling program at 40 Ontario municipal wastewater treatment plants as part of the Municipal-Industrial Strategy for Abatement (MISA) Program. To complement this 40 plant study, an off-gas sampling program was carried out simultaneously at four of the plants. The study of VOC emissions at the four treatment plants was carried out under Phase 1 of this project. The results of the study are covered in this report.

1.2 Project Objectives

The objectives of Phase 1 of the project are as follows:

a. To measure the removal of selected volatile organic pollutants by air stripping in aerated process vessels of representative full scale municipal wastewater treatment plants.

b. To evaluate the potential effects of plant operating and design variables on the stripping process.

c. To evaluate the usefulness of theoretical models for predicting the stripping of VOCs in full scale treatment plants.

1.3 Project Scope

Off-gas sampling was carried out, during the summer of 1987, at four municipal wastewater treatment plants in Ontario: (1) Burlington Skyway (22-26 June); (2) Toronto Highland Creek (29 June-3 July); (3) Mississauga Lakeview (13-17 July); and (4) Waterloo (20-24 July). The four plants were selected to represent a cross-section of Ontario wastewater treatment plants. A range of heavy (e.g., Lakeview) to light (e.g., Waterloo) industrial waste input is represented. All the plants employ diffused aeration systems but with different diffuser types or different aeration patterns. The Highland Creek plant uses fine bubble diffusers, Skyway uses coarse bubble diffusers in a cross roll pattern, Lakeview uses coarse bubble diffusers in a spiral roll pattern, and Waterloo uses a combination of air spargers and turbine mixers. Three of the plants utilize aerated grit chambers. Only plants using diffused aeration systems were chosen because these allow direct collection and sampling of the process off-gases which is not possible with mechanical surface aeration systems. At each of the plants off-gas samples were collected from the influent end, centre, and effluent end of one aeration basin. In addition, off-gas samples were collected from one location in an aerated grit chamber at each plant except Waterloo which does not have aerated grit chambers. Wastewater samples were also taken at each off-gas sampling location. Sampling at each plant was conducted simultaneously with the 40 plant study sampling program. The

sampling program at each plant was carried out over a five day period in which four twenty-four hour off-gas samples were collected at each sampling location. Wastewater grab samples were taken at the beginning and end of each off-gas sampling run, at each location. Off-gas and wastewater samples were analyzed for the MOE MISA list of volatile organic compounds. Although other compounds were present in the samples, no attempt was made to identify or quantify them. Section 3 of this report describes in detail the sampling and analytical methods employed in the project. In addition to the field work, this project also includes a comprehensive review of the literature pertaining to air stripping of VOCs in municipal wastewater treatment plants. Details of the literature review are presented in Section 2.

2. LITERATURE REVIEW

2.1 Introduction

2.1.1 Problem Definition

It has been shown that volatile organic compounds (VOCs) are stripped from wastewater, into the atmosphere, from aerated process vessels in wastewater treatment plants (Pellizzari and Little, 1980; Lurker et al., 1982; Petrasek et al., 1983a; Dunovant et al., 1986). Although there has been work aimed at developing theoretical and empirical models to predict stripping of VOCs in wastewater treatment plants, these models do not appear to have been conclusively proven in field applications. The ultimate goal of the VOC stripping research is to produce a model which can predict stripping effects based on chemical and physical properties of the compound, and plant operating data. Since other mechanisms may compete with stripping for removal of VOCs (e,g., biodegradation and biosorption), the stripping model must be coupled with models accounting for these other mechanisms.

2.1.2 Scope of the Literature Review

The literature review is required to provide a base of information to aid in analyzing and evaluating the results of the VOC stripping field tests and the pilot plant tests proposed as the second phase of this study. In addition, the literature review provides an information base concerning the behaviour of volatile organic chemicals in wastewater treatment plants and receiving waters. This information is required for the development of meaningful industrial and municipal discharge regulations.

This literature review covers reported work related to air stripping of volatiles in wastewater treatment plants. Bench scale, pilot plant, and full scale studies are included, as well as purely theoretical work. The

scope of this review is limited to studies relating to stripping in conventional wastewater treatment plants. Such subjects as stripping in packed towers and steam stripping are not intended to be covered by this review.

Physical property data for many of the VOCs of interest were found in the literature. These data are listed in Table 2.1.

2.1.3 General Background

A detailed review of the theory related to stripping of VOCs from wastewater is given by Roberts et al. (1984a). Fundamentals of the mass transfer process of desorption of volatile compounds from a liquid medium have been covered by Treybal (1968). The following information, taken from these sources, summarizes the theoretical basis upon which VOC stripping models are based. Other useful reviews of the subject have been published (Camp, 1958; Thibodeaux, 1975; Mackay, 1978; Mackay, 1980; Mackay, 1981; McCarty, 1983).

Henry's Law

To develop a stripping model, a relationship between the liquid phase and gas phase equilibrium concentrations of the VOC should be known. For low concentrations, this relationship is usually given by Henry's law, which is expressed as

$$C_G = HC_L \qquad (1)$$

where

C_G = gas phase concentration of compound,
C_L = liquid phase concentration of compound,
H = Henry's law constant.

Table 2.1 Properties of Volatile Organic Compounds

Compounds	M.W.	Henry's Law Constant (atm.m^3/mol x 10^3)	Henry's Law Constant (dimensionless)	Diffusion Coeff. (water) (cm^2/s)
1,1-Dichloroethylene	97.00	15.00	0.62	
Dichloromethane	85.00	3.19	0.13	1.17E-05
trans-1,2-Dichloroethylene	96.94	5.32	0.22	
1,1-Dichloroethane	99.00	5.45	0.23	
Chloroform	119.40	3.39	0.14	1.00E-05
1,2-Dichloroethane	98.76	1.10	0.05	9.90E-06
1,1,1-Trichloroethane	133.40	4.92	0.20	8.80E-06
Benzene	78.10	5.55	0.23	9.80E-06
Tetrachloromethane	153.80	30.20	1.26	8.80E-06
Dibromomethane	173.85	1.00	0.04	
1,2-Dichloropropane	112.99	2.82	0.12	8.73E-06
Bromodichloroethane	129.39	2.12	0.09	
Trichloroethylene	131.39	9.10	0.38	9.10E-06
1,1,2-Trichloroethane	133.40	11.70	0.49	8.80E-06
Toluene	92.00	5.93	0.25	8.60E-06
Dibromochloromethane	208.29	0.78	0.03	
1,2-Dibromoethane	187.88			
Tetrachloroethylene	165.90	28.70	1.19	8.20E-06
Ethylbenzene	106.16	6.44	0.27	7.80E-06
m,p-xylene	106.16	5.24	0.22	7.80E-06
Bromoform	252.77	0.53	0.02	
1,1,2,2-Tetrachloroethane	168.00	0.38	0.02	7.90E-06
o-xylene	106.17	5.27	0.22	
Cumene	120.20	14.60	0.61	7.10E-06
Propylbenzene	120.19	6.59	0.27	
4-Ethyltoluene	120.20			
3-Ethyltoluene	120.20			
1,3,5-Trimethylbenzene	120.20	147.00	6.11	
2-Ethyltoluene	120.20			
1,2,4-Trimethylbenzene	120.20			
1,3-Dichlorobenzene	147.01	2.63	0.11	7.86E-06
1,4-Dichlorobenzene	147.00	2.72	0.11	7.90E-06
1,2-Dichlorobenzene	147.00	1.94	0.08	7.90E-06
1,3-Diethylbenzene	134.22			
1,4-Diethylbenzene	134.22			
1,2-Diethylbenzene	134.22			

Two-Film Theory

Several different theories have been developed to describe mass transfer across a liquid/gas interface. In the two-film theory, the solute must diffuse from one bulk phase, through liquid and gas films at the interface, into the other bulk phase. The solute concentrations in the bulk phases are taken to be uniform, while concentration gradients exist in the film layers. The solute is transported through the film layers by molecular diffusion in response to the concentration gradients. It is assumed that the gas and liquid are at equilibrium at the interface. Since concentrations in the film layers cannot normally be measured, the mass transfer rate is usually expressed in terms of an overall mass transfer coefficient. Overall mass transfer coefficients may be based on the liquid or gas phase, but for stripping in wastewater treatment plants, the liquid phase based coefficients are normally used. The rate of mass transfer is expressed as

$$- dm/dt = K_L A(C_L - C_L^*) \tag{2}$$

where

dm/dt = mass transfer rate,
K_L = overall mass transfer coefficient based on liquid phase,
A = interfacial area between gas and liquid phases,
C_L^* = liquid phase concentration corresponding to equilibrium with the gas phase concentration.

The overall mass transfer coefficient can be expressed in terms of the individual film coefficients and the Henry's law coefficient

$$1/K_L = 1/k_L + 1/(Hk_G) \tag{3}$$

where

k_L = liquid film mass transfer coefficient,

k_G = gas film mass transfer coefficient.

For highly volatile compounds (high H), the gas phase resistance to mass transfer is negligible compared to the liquid phase resistance and thus

$$K_L = k_L \tag{4}$$

The two-film theory predicts that the mass transfer coefficients are directly proportional to the diffusion coefficients. Therefore, the mass transfer coefficient for a VOC could be predicted if, under the same fluid-flow conditions, the mass transfer coefficient for another compound (e.g., oxygen) were known. The ratio of the mass transfer coefficients would equal the corresponding ratio of diffusion coefficients. Since oxygen transfer rates in wastewater treatment systems have been extensively measured, this is a potentially useful relationship.

Penetration Theory

In the penetration theory, small turbulent eddies are postulated to move through the bulk phase to the interface where they remain for a short time before moving back into the bulk solution. The time the eddies remain at the interface is short, so that steady state conditions are never reached. At the interface, solute molecules are assumed to penetrate into the eddies through molecular diffusion. Penetration theory predicts that the mass transfer coefficient will be proportional to the square-root of the diffusion coefficient, in contrast with the direct proportionality predicted by the two-film theory.

Surface-Renewal Theory

The surface-renewal theory extends the penetration theory by assuming that the residence times of the eddies at the interface vary from zero to infinity, in contrast to the constant residence time of penetration theory. This theory, like the penetration theory, predicts that the mass transfer coefficient will be proportional to the square-root of the diffusion coefficient.

Film-Penetration theory

This theory employs a combination of the previous three theories. In this theory, surface renewal is postulated to take place by penetration of turbulent eddies from the bulk phase. Mass transfer through young surface elements is characterized by penetration theory ($k \propto D^{0.5}$). Transfer through old surface elements obeys film theory ($k \propto D$) and transfer through elements of intermediae age is characterized by a combination of both mechanisms. The film-penetration theory predicts that

$$k \propto D^n \qquad (5)$$

where

k = the liquid or gas film mass transfer coefficient,

D= the liquid or gas phase diffusion coefficient,

n = exponent which may have any value from 0.5 to 1.0.

2.2 Theoretical Models of Volatilization Phenomena

2.2.1 Introduction

In general, volatilization models have been developed for three different classes of wastewater treatment or disposal systems. Two types of artificially aerated systems have been modeled, those employing diffused aeration and those employing surface aeration. The other class of systems

are the nonaerated systems which may include open tanks and basins, ponds, lagoons, lakes, streams, or other related systems. In nonaerated systems the rate of volatilization is related to water and air movement caused by wind and stream flow. In artificially aerated systems wind and stream flow are usually not considered directly, as the mass transfer rate is largely a function of the induced aeration. In some cases, such as surface aerated lagoons, it is necessary to consider the system as consisting of zones of forced convection and zones of natural convection. In that case, models applying to aerated systems and models applying to nonaerated systems may be used in combination. Farino et al. (1983) present a review and evaluation of models for estimating air emissions from various types of waste treatment, storage and disposal facilities.

2.2.2 Surface Aerated Systems

Volatilization models for surface or mechanically aerated systems, usually employ a rate equation of the form of Equation 2,

$$- dm/dt = K_LA(C_L - C_L^*) \qquad (2)$$

Equation 2 can be written in terms of the rate of concentration change,

$$dC/dt = - K_La(C_L - C_L^*) \qquad (6)$$

where

a = specific interfacial area (area per unit volume)

For surface aeration, C_L^* is usually taken to be zero since the atmosphere around the aerator is considered to be free of the volatilizing compound. This approximation is based on the assumption that atmospheric turbulence is sufficient to prevent an appreciable buildup of the volatile compound in the air surrounding the aerator (Barton, 1986; Roberts et al., 1984b). This leads to the first order rate equation,

$$dC/dt = - K_LaC_L \qquad (7)$$

For the case of a continuous stirred tank reactor (CSTR) with complete mixing and no loss of the volatile compound due to biodegradation, sorption, or other processes, the fractional removal, F_V, of the VOC by volatilization can be determined by a mass balance to be (Barton, 1986; Roberts et al., 1984b; Roberts and Levy, 1985),

$$F_V = 1 - (1 + K_L aV/Q_L)^{-1} \tag{8}$$

where

V = reactor volume,

Q_L = volumetric flow rate of liquid.

For identical CSTRs in series the fractional removal by volatilization is (Metcalf and Eddy, Inc., 1979),

$$F_V = 1 - (1 + K_L aV/Q_L)^{-n} \tag{9}$$

where

V = volume of each reactor,

n = number of reactors.

For a plug flow reactor (PFR), the fractional removal by volatilization in the absence of competing removal mechanisms is given by (Thibodeaux, 1975),

$$F_V = 1 - \exp(-K_L aV/Q_L) \tag{10}$$

2.2.3 Diffused Aeration Systems

Equation 6 is not appropriate for diffused air systems since C_L^* varies as the air bubbles rise through the liquid (Roberts et al., 1984b).

Assuming a constant K_L over the depth range, that Henry's law applies at the bubble-liquid interface, and constant air flow and temperature, the fractional removal of a VOC by volatilization in a CSTR using diffused aeration is given by (Matter-Muller et al., 1981; Roberts et al., 1984b),

$$F_V = 1 - [1 + HQ_G/Q_L(1 - \exp(-K_LaV/HQ_G))]^{-1} \qquad (11)$$

where

H = Henry's law constant, dimensionless,

Q_G = volumetric flow rate of gas (air).

The fractional removal in a series of identical reactors is then given by,

$$F_V = 1 - [1 + HQ_G/Q_L(1 - \exp(-K_LaV/HQ_G))]^{-n} \qquad (12)$$

where

V = volume of each reactor,

n = number of reactors in series.

For a batch reactor, Matter-Muller, et al. (1981) give the following equation,

$$-\ln(C_L/C_L^o) = (Q_GH/V)[1 - \exp(-K_LaV/HQ_G)]t \qquad (13)$$

where

t = time from start of volatilization,

C_L^o = liquid phase concentration of VOC at $t = 0$.

The fractional removal for a PFR can be obtained by substituting the liquid residence time, V/Q_L, for t and $F_V = 1 - C_L/C_L^o$ to obtain,

$$F_V = 1 - \exp[(-Q_GH/Q_L)(1 - \exp(-K_LaV/HQ_G))] \qquad (14)$$

2.2.4 Nonaerated Systems

Volatilization models for nonaerated systems are essentially the same as for surface aerated systems. As with mechanically aerated systems, it is normally assumed that the buildup of VOCs in the air over the liquid surface is negligible, and therefore that C_L^* is approximately zero. For a quiescent surface the interfacial surface area equals the area of the water surface, and therefore the specific interfacial area, a, is equal to the reciprocal of the average water depth, 1/h. The equations for fractional removal of a VOC by volatilization from a nonaerated water body thus become (U.S. Environmental Protection Agency, 1987; Mackay and Yeun, 1983),

for a CSTR,

$$F_v = 1 - (1 + K_L V/hQ_L)^{-1} \tag{15}$$

for a series of identical CSTRs,

$$F_v = 1 - (1 + K_L V/hQ_L)^{-n} \tag{16}$$

and for a PFR,

$$F_v = 1 - \exp(-K_L V/hQ_L) \tag{17}$$

2.2.5 Estimation of Mass Transfer Coefficients

2.2.5.1 Experimental Approach

To use the models described above the overall mass transfer coefficient must be estimated for the compound in question. Three general approaches have been employed for estimating mass transfer coefficients for

volatilization. The first approach involves the use of laboratory experiments to determine the ratio of the mass transfer coefficient of the VOC to that of a reference compound. It is assumed that this ratio is constant and independent of mixing conditions. Therefore, once this ratio is known, the mass transfer coefficient for the VOC can be determined if the mass transfer coefficient for the reference compound is known. The usual reference compound for the liquid phase mass transfer coefficient is oxygen for which a large volume of mass transfer information is available. Redmon et al. (1983) give a method for measuring oxygen transfer. For the gas phase, water is the usual reference compound. In addition to the large volume of information available concerning the mass transfer of these reference compounds, an advantage is that, in the systems of concern, oxygen transfer is essentially totally controlled by the liquid phase resistance and mass transfer of water is controlled only by the gas phase resistance. This method for estimating mass transfer coefficients has been proposed by Rathbun et al. (1978), Rathbun and Tai (1981, 1984a, 1984b, 1987) , Smith and Bomberger (1979), Smith et al. (1980), and Okouchi (1986). The ratio of mass transfer coefficients for two compounds has been shown to be independent of mixing conditions in experimental systems (Tsivoglou et al, 1965; Rathbun et al., 1978; Smith and Bomberger, 1980; Roberts and Dandliker, 1983; Okouchi, 1986). Rathbun et al. (1978), Smith and Bomberger (1980), and Matter-Muller et al. (1981) have also shown the ratio to be independent of the presence of surfactants. Tsivoglou et al. (1965), Rathbun et al. (1978), and Okouchi (1986) also observed that the ratios were independent of temperature. The approach using the experimental method then is given by equations 18 and 19,

$$(k_L^{org}/k_L^{ref})_{lab} = \psi = (k_L^{org}/k_L^{ref})_{fld} \tag{18}$$

$$(k_G^{org}/k_G^{ref})_{lab} = \beta = (k_G^{org}/k_G^{ref})_{fld} \tag{19}$$

where

k_L^{org}, k_G^{org} = liquid phase and gas phase mass transfer coefficients for the organic compound, respectively,

k_L^{ref}, k_G^{ref} = liquid phase and gas phase mass transfer coefficients for the reference compound, respectively,

subscripts lab and fld refer to laboratory and field conditions, respectively.

The major disadvantage of this approach is that laboratory tests must be carried out for each compound of interest.

2.2.5.2 Theoretical Approach

The most desirable approach to estimation of mass transfer coefficients is to make the estimates based on mass transfer theory using basic physical properties of the compounds. As described in Section 1.3, the various mass transfer theories predict that the mass transfer coefficient will be proportional to some power of the diffusivity. In turn, diffusivity has been shown to be proportional to other physical properties of the compound. The theoretical approaches to estimating mass transfer coefficients for volatilization utilize these relationships. Because the complex mixing conditions in an actual system cannot readily be described by theory, the actual mixing conditions are characterized by the mass transfer coefficient of a reference compound for which relationships between mixing conditions and mass transfer have been developed. The approach is similar to that described in Section 2.2.5.1 above, except that the ratios of the mass transfer coefficients are derived from ratios of appropriate physical properties rather than from experiment. The physical properties which have been proposed are diffusivity, molecular weight, molecular diameter, and molecular volume. Correlations for the mass transfer coefficients take the form,

$$k_{org} = k_{ref}(D_{org}/D_{ref})^w \tag{20}$$

$$k_{org} = k_{ref}(M_{org}/M_{ref})^x \tag{21}$$

$$k_{org} = k_{ref}(d_{org}/d_{ref})^y \tag{22}$$

$$k_{org} = k_{ref}(V_{org}/V_{ref})^z \tag{23}$$

where

k_{org} = liquid or gas phase mass transfer coefficient for the organic compound,

k_{ref} = liquid or gas phase mass transfer coefficient for the reference compound,

D_{ref}, D_{org} = diffusion coefficients of the reference compound and organic compound, respectively,

M_{ref}, M_{org} = molecular weights of the reference compound and organic compound, respectively,

d_{ref}, d_{org} = molecular diameters of the reference compound and organic compound, respectively,

V_{ref}, V_{org} = molecular volumes of the reference compound and organic compound, respectively,

w, x, y, z = exponents depending on particular mass transfer theory.

Table 2.2 summarizes some relationships between mass transfer coefficients and diffusion coefficients reported by different investigators.

Atlas et al. (1982) reported that the ratios of overall mass transfer coefficients of some organic compounds to that of oxygen could be predicted by a ratio of the respective diffusion coefficients. Roberts and Dandliker (1983) and Roberts et al. (1984a) observed that the ratios of liquid phase mass transfer coefficients of some halogenated hydrocarbons to that of oxygen were proportional to the 0.66 power of the ratio of the respective diffusion coefficients for surface aeration. For diffused aeration Roberts

Table 2.2 Summary of Reported Relationships Between Mass Transfer Coefficients and Diffusion Coefficients

Reported Value of n in Relationship $k \propto D^n$	Reference
1.0	Atlas et al. (1982)
0.66	Roberts and Dandliker (1983)
0.66	Roberts et al. (1984a)
0.67 - 0.91	Roberts et al. (1984a)
0.43 - 0.51	Munz and Roberts (1984)
1.0	Rathbun et al. (1978)
0.895	Rathbun and Tai (1982a)
0.538 - 0.747	Rathbun and Tai (1987)
0.719	Rathbun and Tai (1982b)
0.61	Smith et al. (1980)
0.58 - 1.06	Smith et al. (1981)
0.5	Kyosai et al. (1981)

et al. (1984a) found the ratio of mass transfer coefficients to be proportional to the ratio of diffusion coefficients to the 0.67 to 0.91 power. The ratios of liquid and gas phase mass transfer coefficients of some halogenated hydrocarbons to that of a reference compound were reported to be proportional to the 0.45 power of the diffusion coefficients for surface aeration and to the 0.43 to 0.51 power for diffused aeration (Munz and Roberts, 1984).

The ratios of mass transfer coefficients of ethylene and propane to that of oxygen were reported to be proportional to the ratios of the diffusion coefficients (Rathbun et al., 1978). Rathbun and Tai (1982a) found the mass transfer coefficient ratio for ethylene and propane to be proportional to the 0.895 power of the diffusion coefficient ratio. Rathbun and Tai (1987) reported the mass transfer coefficient ratio of ethylene dibromide and oxygen to be proportional to the diffusion

coefficient ratio to the 0.538 to 0.747 power depending on the value chosen for the diffusion coefficient of oxygen. The liquid film mass transfer coefficients for a number of ketones were shown to vary with the 0.719 power of the diffusion coefficients (Rathbun and Tai, 1982b).

Chiou et al. (1983) observed that the mass transfer ratios of two high Henry's law coefficient compounds were correlated with the ratio of diffusion coefficients to a power, but that the correlation could not predict the ratio of transfer coefficients of a high H compound to that of a low H compound. Smith et al. (1980) reported that the ratios of mass transfer coefficients of some high volatility compounds with that of oxygen was proportional to the diffusion coefficients to the 0.61 power. Smith et al. (1981) found the liquid phase mass transfer coefficient ratios of napthalene and anthracene to that of oxygen to be proportional to the 0.58 and 0.98 power of the diffusion coefficient ratio respectively. The gas phase mass transfer coefficient ratios for the same compounds were proportional to the 0.80 and 1.06 power of the diffusion coefficient ratios. The mass transfer coefficient ratios of two other compounds could not be correlated with the diffusion coefficient ratios. Kyosai et al. (1981) reported that the mass transfer coefficient ratio of methylene chloride and oxygen was approximately proportional to the square root of the diffusion coefficient ratio.

Some investigators have reported that the ratios of overall mass transfer coefficients of organic compounds to that of oxygen are not constant between different systems (Blackburn et al., 1984; Truong and Blackburn, 1984; Blackburn et al., 1985). It appears that in many cases, but not all, the ratio of mass transfer coefficients is proportional to the ratio of diffusion coefficients to the 0.5 to 1.0 power as predicted by different theoretical models. Most of the studies reported in the literature outlined above are based on laboratory tests, and the theoretical models have not been fully proven in field tests. The results of the laboratory testing do not provide conclusive guidance as to which model to use to predict volatilization under field conditions.

It has been shown that, for spherical molecules, molecular diffusion coefficients are inversely proportional to molecular diameters (Reid and Sherwood, 1966). Therefore, in theory, mass transfer coefficients should be proportional to some power of the molecular diameters. Tsivoglou et al. (1965) found the ratio of mass transfer coefficients of krypton and radon to oxygen to be proportional to the inverse ratio of the respective molecular diameters. Paris et al. (1978) observed similar results for polychlorinated biphenyls. Smith and Bomberger (1979) reported similar results for high volatility organic compounds but not for low volatility compounds. For high volatility organic compounds, Smith and Bomberger (1980) found the ratios of mass transfer coefficients of high volatility organics to that of oxygen to be proportional to the inverse ratio of the molecular diameters to the 0.5 power. This correlation did not hold for low volatility compounds.

Liss and Slater (1974) proposed that the gas phase mass transfer coefficients for the flux of gases across the air-sea interface could be predicted by multiplying the mass transfer coefficient for evaporation of water by the ratio of the square roots of the molecular weights of water and the other gas. Similarly, the liquid phase mass transfer coefficients could be obtained by multiplying the the mass transfer coefficient for carbon dioxide by the ratio of the square roots of the molecular weights of carbon dioxide and the other gas. Dilling (1977) tested the model of Liss and Slater for 27 chlorinated hydrocarbons and found reasonably good agreement for compounds with a dimensionless Henry's law coefficient greater than approximately 0.1. The ratio of the mass transfer coefficients of propane and ethylene were found to be proportional to the square root of the inverse ratio of molecular weights (Rathbun and Tai, 1982a). The ratios of mass transfer coefficients of a number of ketones with that of oxygen were found to to be proportional to the ratios of the molecular weights to the -0.263 to -0.378 power (Rathbun and Tai, 1982b). Rathbun and Tai (1987) reported that the ratio of the mass transfer coefficient for volatilization of ethylene dibromide to that of oxygen predicted by the square root of the inverse ratio of the molecular weights

gave a value 32% less than the experimental value.

Mackay (1981) suggested correlating the mass transfer coefficients with the -0.3 power of the molecular volume. Matter-Muller et al. (1980) and Matter-Muller et al. (1981) reported that the ratio of mass transfer coefficients of some hydrocarbons and chlorinated hydrocarbons to that of oxygen were proportional to the inverse ratio of the critical volumes to the 0.5 power.

Mackay and Wolkoff (1973) derived an equation to determine the rate of evaporation of low-solubility contaminants from water bodies to the atmosphere. For a batch system the change in concentration of the contaminant over time is given by,

$$\ln(C_L^o/C_L) = EP_S M 10^6 t/(18GP_W C_S) \tag{24}$$

where

C_L^o = the initial concentration of the contaminant,
C_L = the contaminant concentration at time t,
E = evaporation rate of water, g/d,
P_S = vapour pressure of the pure contaminant,
M = molecular weight of the contaminant,
t = time,d
G = mass of water,g,
P_W = vapour pressure of water,
C_S = solubility of the contaminant,ppm.

This equation assumes perfect mixing and that as the contaminant evaporates no concentration gradients occur. This situation is unlikely to occur in practical situations. Dilling et al. (1975) and Dilling (1977) tested the Mackay and Wolkoff model and found that volatilization rates predicted by the model did not agree well with experimental results.

2.2.5.3 Empirical and Semiempirical Correlations

A number of empirical or semiempirical correlations have been developed to estimate mass transfer coefficients or rate constants for volatilization. These correlations are described in the following sections under four categories: (1) non-aerated systems; (2) surface aerated systems - turbulent zone; (3) surface aerated systems - natural convection zone: (4) diffused aeration systems.

Non-aerated systems

Rathbun and Tai (1982a) correlated the liquid phase mass transfer coefficient, k_L, in a laboratory system, using an equation of the form,

$$k_L = aD^bN^cY^d \tag{25}$$

where

D = molecular diffusion coefficient,

N = stirrer rpm,

Y = water depth,

a,b,c, and d = adjustable parameters.

This correlation would not necessarily be applicable to field conditions using parameters developed in a laboratory system.

Chiou et al. (1980) proposed the use of the following correlation for the volatilization rate constant:

$$k_v = abH(M/2\pi RT)^{1/2} \tag{26}$$

where

a = ratio of VOC concentration at the liquid surface to that in the bulk liquid phase,

b = dimensionless evaporation coefficient depending on atmospheric pressure and air turbulence,

M = molecular weight of VOC,

R = gas constant,

T = absolute temperature of the solution.

This model was reported to provide estimated volatilization rates consistent with laboratory experimental results.

Rathbun and Tai (1984a) correlated the volatilization flux rate of some ketones with the following equation:

$$W_v = 2.47 \times 10^{-2} P_s^{0.883} \exp(0.0150T) \tag{27}$$

where

W_v = volatilization flux, g/min m^2,

P_s = vapour pressure of the organic compound, mm Hg,

T = temperature, ^{o}K.

Rathbun and Tai (1982a) correlated the volatilization rate constants of ethylene and propane determined in stream experiments with various one, two, and three variable models. Equations of the following forms were used for the correlations:

$$k_v = aX_1^{b} \tag{28}$$

$$k_v = aX_1^{b}X_2^{c} \tag{29}$$

$$k_v = aX_1^{b}X_2^{c}X_3^{d} \tag{30}$$

where

X_i = independent variable,

a,b,c, and d = adjustable parameters.

Various combinations of the following variables were correlated:

U = average water velocity,

Y = average depth of flow,

S = slope of the stream channel,

U_* = shear velocity = $(gYS)^{1/2}$, where g = gravitational constant,

US = combination of variables U and S.

For one variable correlations, the equation based on US had the smallest error. The equations based on US and Y, and U and S had the smallest errors of the two variable correlations. The variables used in the three variable correlations were U, S, and Y. Overall the best predictive equations were the two variable equation containing US and Y and the three variable equation containing U, S, and Y.

The following correlations for the gas phase and liquid phase mass transfer coefficients for volatilization of polycyclic aromatic hydrocarbons (PAH) from a water body are given by Southworth (1979):

$$k_G = 1137.5(V_w + V_c)(18/M)^{1/2} \tag{31}$$

$$k_L = 23.51(V_c^{0.969}/Y^{0.673})(32/M)^{1/2} \tag{32}$$

for V_w less than or equal to 1.9 m/s

$$k_L = 23.51(V_c^{0.969}/Y^{0.673})(32/M)^{1/2}\exp(0.526(V_w - 1.9)) \tag{33}$$

for V_w greater than 1.9 m/s

where

k_G = gas phase mass transfer coefficient, cm/h,

k_L = liquid phase mass transfer coefficient, cm/h,

V_w = wind velocity, m/s,

V_c = current velocity, m/s,

M = molecular weight of PAH,

Y = mean depth of water, m.

Based on studies in a laboratory wind-wave tank Cohen et al. (1978) developed a correlation for the liquid phase mass transfer coefficient for volatilization of toluene and benzene,

$$k_L = 11.4Re^{*0.195} - 5.0 \quad (34)$$

for Re^* from 0.11 to 102 and

$$Re^* = 7.07 \times 10^{-3} Z_{10}U_{10}/vis_a \exp(56.6/U_{10}^{0.25}) \quad (35)$$

where

k_L = liquid phase mass transfer coefficient, cm/h

Re^* = roughness Reynolds number, dimensionless,

U_{10} = wind velocity in cm/s at height Z_{10} in cm above the water,

vis_a = kinematic viscosity of air.

Hwang (1981) proposed that Cohen's correlation could be used to estimate the mass transfer coefficients for other compounds volatilizing from a natural water surface by multiplying the toluene mass transfer coefficient by the ratio of diffusion coefficients of the compound and toluene. Thibodeaux et al. (1982) recommend multiplying Cohen's correlation by the square root of the ratio of molecular weights of benzene and the compound to estimate the liquid phase mass transfer coefficient for the quiescent area of a wastewater basin.

Based on measurement of volatilization rates of 11 organic compounds in a wind-wave tank Mackay and Yeun (1983) suggested the following correlations for gas phase and liquid phase mass transfer coefficients:

$$k_G = 1.0 \times 10^{-3} + 46.2 \times 10^{-3} U^* Sc_G^{-0.67} \tag{36}$$

$$k_L = 1.0 \times 10^{-6} + 34.1 \times 10^{-4} U^* Sc_L^{-0.5} \quad (U^* > 0.3) \tag{37}$$

$$k_L = 1.0 \times 10^{-6} + 144 \times 10^{-4} U^{*2.2} Sc_L^{-0.5} \quad (U^* < 0.3) \tag{38}$$

where

k_G = gas phase mass transfer coefficient, m/s,

k_L = liquid phase mass transfer coefficient, m/s,

U^* = air side friction velocity, m/s, = $10^{-2}(6.1+0.63U_{10})^{0.5}\, U_{10}$ #

U_{10} = wind velocity 10 m above the water surface, m/s,

Sc_G = gas phase dimensionless Schmidt number = viscosity/(density x diffusivity),

Sc_L = liquid phase dimensionless Schmidt number.

Mackay and Matsugu (1973) developed a correlation for the gas phase mass transfer coefficient for evaporation of liquid hydrocarbon spills using data from evaporation of cumene and water. The proposed correlation equation is,

$$k_G = 0.0292 U^{0.78} X^{-0.11} Sc^{-0.67} \tag{39}$$

where

k_G = gas phase mass transfer coefficient, m/h,

U = wind speed, m/h,

X = pool diameter, m,

Sc = dimensionless Schmidt number previously defined.

Note that conflicting information is given by Mackay and Yeun (1983) concerning the relationship for U^*. The relationship given here is believed to be correct.

Freeman (1979) and Shen (1982) suggest the use of this correlation in estimating the emissions of organic compounds from waste treatment basins.

Numerous correlations have been developed to relate reaeration rates of rivers to river velocity, depth, and slope. Mackay and Yuen (1980) and Bowie et al. (1985) present some of these correlations and list references which give comprehensive reviews of this subject, such as Bennett and Rathbun (1971). Assuming one of the theoretical mass transfer mechanisms applies, these correlations can be adapted to estimate volatilization rates in rivers, streams or similar water bodies.

Mechanical surface aeration systems

For a mechanical surface aerator, the liquid phase mass transfer coefficient of an organic compound can be related to the oxygen transfer rate constant, for which reliable correlations are available. The following correlation employs a standard oxygen transfer correlation and assumes a penetration theory mechanism (Thibodeaux and Parker, 1976; Thibodeaux, 1979; Thibodeaux et al., 1982):

$$k_La = 6.06 \times 10^3 (D_{org}/D_{oxy})^{1/2} N_{oxy} EPf(1.024)^{T-20}/V \quad (40)$$

where

- k_L = liquid phase mass transfer coefficient of the VOC, lb mol/h-ft^2,
- a = specific interfacial surface area, ft^2/ft^3,
- D_{org} = diffusion coefficient of the VOC in water, cm^2/s,
- D_{oxy} = diffusion coefficient of oxygen in water, cm^2/s,
- N_{oxy} = oxygen transfer rating of aerator, lbs O_2/hp h,
- E = aerator power delivery efficiency, dimensionless,
- P = nameplate horsepower, hp,
- f = correction factor for wastewater/clean water oxygen transfer, dimensionless,

T = water temperature, ^{o}C,

V = volume of agitated water, ft^3.

The following correlation for the gas phase mass transfer coefficient for a mechanical surface aerator has been proposed (Thibodeaux and Parker, 1976; Thibodeaux, 1979):

$$Sh = 2.0 + 0.347(ReSc^{1/2})^{0.62} \tag{41}$$

where

Sh = dimensionless Sherwood number =(gas phase mass transfer coefficient x droplet diameter)/(air density x diffusion coefficient of VOC in air),

Re = dimensionless Reynold's number = droplet diameter x droplet velocity/kinematic viscosity of air,

Sc = dimensionless Schmidt number = kinematic viscosity of air/ diffusion coefficient of VOC in air.

An improved correlation was developed by Reinhardt (1977) and has been proposed for use in estimating VOC emmissions from surface aerated wastewater treatment basins (Freeman, 1979; Hwang, 1981; Thibodeaux et al., 1982). Reinhardt's correlation is,

$$Sh = 3.9 \times 10^{-4} Re^{1.42} Po^{0.40} Sc^{0.5} / Fr^{0.21} \tag{42}$$

where

Sh = dimensionless Sherwood number = (gas phase mass transfer coefficient x impeller diameter)/(air density x diffusion coefficient of VOC in air),

Re = dimensionless Reynold's number = impeller diameter^2 x rotational speed of impeller/kinematic viscosity of air,

Po = dimensionless power number = (power to impeller x Newton's law conversion factor)/(liquid density x impeller diameter^5 x rotational speed of impeller^3),

Sc = dimensionless Schmidt number = kinematic viscosity of air/ diffusion coefficient of VOC in air,

Fr = dimensionless Froude number =impeller diameter x rotational speed of impeller^2/gravitational constant.

For the zones of natural convection in a surface aerated wastewater basin, the stream reaeration equation developed by Owens et al. (1964) has been adapted to estimate the liquid phase mass transfer coefficient (Thibodeaux and Parker, 1976; Thibodeaux, 1979; Freeman, 1979; Hwang, 1981). Assuming the natural surface approaches the film theory mechanism of mass transfer, the correlation is,

$$k_L = 5.78(D_{org}/D_{oxy})v^{0.67}h^{-0.85}(1.024)^{T-20} \tag{43}$$

where

k_L = liquid phase mass transfer coefficient, lb mol/h ft^2,
v = average stream velocity, cm/s,
h = average water depth, cm.

Harbeck (1962) developed a correlation for the gas phase mass transfer coefficient for water evaporation from reservoirs. Thibodeaux and Parker (1976) adapted this correlation for estimating the gas phase mass transfer coefficient for volatilization of VOCs from the natural convection zones of surface aerated basins by applying the film theory (Thibodeaux, 1979; Thibodeaux et al., 1982). The resulting equation is,

$$k_G = 0.03(D_{org}/D_{wat})U_8A^{-0.5} \tag{44}$$

where

k_G = gas phase mass transfer coefficient of VOC, lbmol/h ft^2,

D_{org} = diffusion coefficient of the VOC in air,

D_{wat} = diffusion coefficient of water vapour in air,

U_8 = wind velocity at 8 m above the water surface, mi/h,

A = surface area of the basin, acres.

For the natural convection zones, the specific interfacial surface area, a, is given by (Thibodeaux, 1979),

$$a = A/V \tag{45}$$

where

A = plane surface area of water basin,

V = volume of water under plane surface.

For a flat bottom basin a = (depth)$^{-1}$.

Barton (1986) uses the correlation proposed by Mills et al. (1985) for the gas phase mass transfer coefficient for volatilization of organic compounds across a wastewater basin surface:

$$k_Ga = 168(18/M_{org})^{1/4}U_w/Z \tag{46}$$

where

k_Ga = gas phase mass transfer rate constant, h^{-1},

M_{org} = molecular weight of VOC, g/mol,

U_w = ambient wind velocity, m/s,

Z = basin depth, m.

Diffused air systems

Engelbrecht et al. (1961), Gaudy et al. (1961), and Weber and Jones (1986) correlated volatilization rate constants for stripping of VOCs with the air flow rate using an equation of the form,

$$k_V = k_{V,o} + RQ_G \tag{47}$$

where

k_V = the rate constant for volatilization,
$k_{V,o}$ = the rate constant expected with no aeration,
R = rate of change of the rate constant with air flow rate,
Q_G = air flow rate.

Engelbrecht et al. (1961), Gaudy et al. (1961), and Richardson and Ledbetter (1978) observed that VOC stripping data could also be correlated using an equation of the form,

$$k_V = CQ_G{}^n \tag{48}$$

where

C and n = adjustable parameters.

Gaudy et al. (1961), however, found equation 47 to be more generally applicable than equation 48.

Blackburn et al. (1984), Truong and Blackburn (1984), and Blackburn et al. (1985) correlated their stripping rate data with an equation of the form,

$$k_V = bQ_G H^m/V$$

(49)

where

b and m = adjustable parameters,

H = Henry's law constant,

V = reactor volume.

They reported values of $b = 3.71 \times 10^{-3}$ and $m = 1.045$ for stripping of three organic compounds in a pure water system. The values of the parameters b and m changed, however, when contaminants such as oils, salts, and surfactants were added to the system.

For volatilization of organics in diffused air systems Freeman (1982) uses the relation of Calderbank (1967) to estimate the liquid film coefficient,

$$k_L = 0.42 Sc^{-1/2}[(\rho_L - \rho_G)\mu_L g/(\rho_L)^2]^{1/3}(3600)\rho_L/M_w \qquad (50)$$

where

k_L = liquid phase mass transfer coefficient, g mol/h cm^2,

Sc = dimensionless liquid phase Schmidt number,

ρ_L = density of liquid in basin, g/cm^3,

ρ_G = average air density in basin, g/cm^3,

μ_L = viscosity of liquid in basin, g/cm s,

g = gravitational constant, 980.62 cm/s^2,

M_w = molecular weight of water, g/mol.

The specific interfacial area can be estimated as (Calderbank, 1967; Freeman, 1982),

$$a = 1.44(P/V)^{0.4}(\rho_L)^{0.2}(V_G/V_T)^{1/2}(st)^{-0.6} \qquad (51)$$

where

P/V = power per unit volume of basin, g-cm^2/s^3 cm^3,

V_G = superficial gas velocity in basin, cm/s,

V_T = terminal velocity of a rising bubble, cm/s,

st = surface tension, g/s^2.

Roberts et al. (1984a) tested several correlations of the mass transfer coefficient for oxygen transfer in a diffused air system against their experimental data. One of the correlations tested was that of Akita and Yoshida (1974),

$$k_L = 0.5g^{5/8}D_{org}{}^{1/2}(\rho_L)^{3/8}(st)^{-3/8}d_p{}^{1/2} \tag{52}$$

where

k_L = liquid phase mass transfer coefficient, m/s,

g = gravitational constant, 9.81 m/s^2,

D_{org} = liquid phase diffusion coefficient, m^2/s,

ρ_L = liquid density, kg/m^3,

st = surface tension, kg/s^2,

d_p = bubble diameter, m.

Roberts et al. (1984a) also tested simplified versions of the correlations of Yaron and Gal-Or (1971) assuming the gas holdup ratio is small and the effect of surfactants is negligible. The simplified correlations are,

$$Sh = 1.037Pe^{1/3} \tag{53}$$

for bubbles with no internal circulation, and

$$Sh = 0.895[(\mu_L/\mu_G)/(2(1 + \mu_L/\mu_G))]^{1/2}Pe^{1/2} \tag{54}$$

for bubbles with strong internal circulation, where

Sh = dimensionless Sherwood number,

Pe = dimensionless Peclet number = $ReSc$,

μ_L = viscosity of liquid phase,

μ_G = viscosity of gas phase.

The velocity term in equations 53 and 54 is taken as the relative velocity between the continuous and dispersed phases, U_{rel}, and is defined as,

$$U_{rel} = -1.5U_s[(e_G^{-1/3} - 1)/(e_G^{-2/3} - 1) - (e_G^{5/3})/W(e_G^{-2/3} - 1) - Y/W] \qquad (55)$$

where

U_s = Stokes velocity = $(\rho_G - \rho_L)gd_p^2/18\mu_L$,

e_G = gas holdup ratio = volume fraction of bubble phase,

$W = 3 + 2(\mu_L/\mu_G) + 2e_G^{5/3}(1 - \mu_L/\mu_G)$,

$Y = 2 + 2(\mu_L/\mu_G) + e_G^{5/3}(3 - 2\mu_L/\mu_G)$.

To estimate the specific interfacial area Roberts et al. (1984a) used the correlation of Akita and Yoshida (1974) to estimate the gas holdup ratio,

$$4Q_G/(\pi d_c^{2.5}g^{1/2}) = 8.887(gd_c\rho_L/st)^{-1/8} (gd_c^3\rho_L^2/\mu_L^2)^{-1/12}e_G^{10/9} \qquad (56)$$

where

Q_G = volumetric gas flow rate,

d_c = column diameter.

Once the gas holdup ratio has been estimated the specific interfacial area can be calculated from,

$$a = 6e_G/d_p \qquad (57)$$

Assuming the liquid phase resistance controls the mass transfer rate, estimates of the overall oxygen transfer rate constant, K_La, can be obtained from equations 52 - 57 and VOC stripping rate constants could possibly be estimated from this. Roberts et al. (1984a) found that experimental oxygen transfer rates were approximately 1.7 greater than those predicted by equation 52, 3.6 times larger than predicted by equation 53, and 1.3 times smaller than predicted by equation 54. Thus VOC stripping rate constants would also be under or overestimated.

Estimation of the overall mass transfer coefficient is simplified if it can be assumed that the mass transfer resistance in one phase is much greater than in the other phase. In that case only the dominant mass transfer coefficient need be estimated to determine the overall coefficient. Depending on the value of the ratio k_G/k_L, values of the Henry's law constant may be selected to define ranges where only one resistance controls the mass transfer rate (see equation 3). The value of $k_G/k_L = 150$ has been inferred by a number of investigators from estimates by Liss and Slater (1974) of k_G for water and k_L for CO_2 at the air sea interface. Mackay and Leinonen (1975) applied the liquid and gas phase mass transfer coefficients suggested by Liss and Slater (1974) to estimate evaporation rates of contaminants from water bodies. They reported that, for those conditions, the phase resistances are approximately equal for H values of 1.6×10^{-4} atm m^3/mol. Dilling (1977) compared experimental volatilization rates with those predicted using the methods of Mackay and Leinonen (1975) and Liss and Slater (1974) and reported reasonably good correlation. Mackay (1978) suggested that, for k_G/k_L in the range 50 to 200 the mass transfer is gas phase controlled for H values below 2×10^{-5} atm m^3/mol and liquid phase controlled for H values above 10^{-3}. Based on k_G/k_L of the order of 150 (range 50 to 300) Mackay et al. (1979) suggested that mass transfer is gas phase controlled for H values below 5×10^{-6} atm m^3/mol and liquid phase controlled for H values above 5×10^{-3}. Mackay (1980) proposed gas phase control for H values less than 2×10^{-5} and liquid phase control for H values greater than 10^{-3} atm m^3/mol. Mackay et al. (1980)

suggested gas phase control for H less than 10^{-4} and liquid phase control for H greater than 10^{-3} atm m^3/mol. Smith et al. (1980, 1981) suggested that mass transfer is gas phase controlled for H values below 1.2 x 10^{-5} atm m^3/mol and liquid phase controlled for H values above 4.4 x 10^{-3}. Roberts and Dandliker (1983) used the criteria of H greater than 4.8 x 10^{-3} atm m^3/mol for liquid phase mass transfer control. The suggested ranges of the Henry's law constant where one phase controls the mass transfer rate are summarized in Table 2.3.

Table 2.3 Suggested Range of Henry's Law Coefficients Where One Phase Resistance Controls the Mass Transfer Rate (H in atm m^3/mol)

Liquid Phase Controls	Gas Phase Controls	Reference
> 1 x 10^{-3}	< 2 x 10^{-5}	Mackay (1978)
> 5 x 10^{-3}	< 5 x 10^{-6}	Mackay (1979)
> 1 x 10^{-3}	< 2 x 10^{-5}	Mackay (1980)
> 1 x 10^{-3}	< 1 x 10^{-4}	Mackay et al. (1980)
> 4.4 x 10^{-3}	< 1.2 x 10^{-5}	Smith et al. (1980,1981)
> 4.8 x 10^{-3}	-	Roberts and Dandliker (1983)

However, Munz and Roberts (1984) reported that K_G/k_L was significantly smaller than 150, hence the gas phase resistance has been underestimated, leading to overestimation of the overall mass transfer rate. They also observed that k_G/k_L varies for a given process depending on hydrodynamic conditions. Roberts et al. (1984a) suggested that k_G/k_L is likely to vary depending on the type of compound, type of system, temperature, and hydrodynamic conditions. They further suggested that the uncertainty in the value of k_G/k_L is almost an order of magnitude. It therefore appears that care must be taken in assuming single phase control of the mass transfer rate. For mass transfer between liquids and gas bubbles, Calderbank (1967) suggested that, at moderate gas flow rates, gas phase resistance is negligible. Thus, for diffused aeration systems, the gas phase resistance can probably be neglected.

2.2.6 Computer-Based Volatilization Models

A number of computer-based models for determining volatilization rates from waste treatment and disposal facilities have been developed. Kuo and Pilotte (1984) present a brief review of some of the available computer-based models for estimating volatilization of toxics from multimedia systems. Barton (1986) developed a computer screening model for estimating the fate of organic compounds in biological wastewater treatment processes. Barton's model includes air stripping, volatilization, biodegradation, and sorption mechanisms for removal of organic compounds from wastewater. The computer program is written in Basic and is designed to be used on an IBM compatible personal computer. Barton's model has been verified for chloroform removal in activated sludge and aerated stabilization basin systems, based on field tests and comparison with literature results. Prediction accuracy for other compounds has not been verified, although, apparently, work in this direction is being carried out. The U.S. Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards has developed a computer-based set of air emission models for hazardous waste treatment, storage and disposal facilities (U.S. EPA, 1987). This set of models is called CHEMDAT4 and is a Lotus 1,2,3 spreadsheet that includes analytical models for estimating VOC emissions from disposal impoundments, closed landfills, land treatment facilities, and aerated and nonaerated treatment processes. The predictions of the CHEMDAT4 model were compared with field test data. The predicted results generally agreed with the measured results, to within an order of magnitude, for surface impoundments and aerated and non-aerated open treatment tanks. The agreement for closed pure oxygen reactors was not as good.

2.2.7 Multi-Mechanism Models

Since mechanisms other than volatilization may contribute to removal of VOCs, models have been developed to predict removal of VOCs in systems where more than one removal mechanism is in effect. In addition to

volatilization, these models generally account for removal by biodegradation and/or sorption on to the biomass in biological treatment systems. In the multi-mechanism models the overall removal rate of the VOC is equal to the sum of the removal rates by the individual mechanisms (Blackburn et al., 1985). In equation form,

$$r_t = r_v + r_b + r_s \tag{58}$$

where

r_t = overall removal rate,
r_v = removal rate by volatilization,
r_b = removal rate by biodegradation,
r_s = removal rate by sorption.

If the individual rates can be expressed in terms of VOC concentrations and other measureable parameters, a predictive model can be developed by inserting the overall rate equation into appropriate mass balance equations for the system. For air stripping by mechanical surface aeration or for volatilization from nonaerated basins, a first order rate equation is generally assumed (see Sections 2.2.2 and 2.2.4). For stripping by diffused aeration some models assume that the exiting gas bubbles are in equilibrium with the liquid phase (Namkung and Rittmann, 1986, 1987). Assuming the gas phase VOC concentration can be expressed by Henry's law, the rate of removal of the VOC can be related to the gas flow rate, the liquid phase VOC concentration, and the Henry's law constant. The assumption that equilibrium is achieved between gas and liquid implies that the mass transfer rate is fast enough to allow the rising bubbles to reach saturation before leaving the system. For some compounds and some systems this assumption may not be valid (see Section 2.2.3). The advantage of such a simplification is that the mass transfer coefficient need not be estimated, and the volatilization rate can be expressed in terms of readily available parameters. Since the concentrations of VOCs normally found in

municipal wastewater treatment plants are low, the biodegradation rate is usually assumed to have a first order dependence on VOC concentration. Where high concentrations of volatile organics are present, as in an industrial treatment system, a zero order rate equation has been used (Gaudy et al, 1963). If sorption on to the biomass is considered as a removal mechanism, it is usually assumed that the mass transfer rate is fast enough that equilibrium is achieved between the biomass and the liquid phase. The rate of removal by sorption can then be related to an equilibrium expression relating liquid and solid phase concentrations and the rate of solids removal from the system.

Gaudy et al. (1963) used the following rate equation to model laboratory data for removal of high concentrations (1000 mg/L) of acetone and butanone in a biological reactor:

$$r_t = k_v C + k_b \tag{59}$$

where

k_v = volatilization rate constant,
C = liquid phase concentration of the VOC,
k_b = biodegradation rate constant.

Weber and Jones (1986) modelled the removal of organic compounds in an activated sludge system using first order rate equations for volatilization and biodegradation, and assuming equilibrium conditions for sorption on to biological solids. The biosorption equilibrium condition is represented by a linear sorption equation,

$$q = K_p C \tag{60}$$

where

q = concentration of organic sorbed on to solids,

K_p = partition coefficient for sorption,

C = liquid phase VOC concentration,

Assuming a complete mix system, steady state conditions, and no suspended solids in the effluent, the resulting mass balance equation is,

$$Q_oC_o = Q_eC + Vk_vC + Vk_bC + K_pCM_sQ_s \tag{61}$$

where

Q_o = influent volumetric flow rate of wastewater,

C_o = VOC concentration in wastewater influent,

Q_e = effluent volumetric flow rate,

C = VOC concentration in wastewater effluent

V = biological reactor volume,

M_s = mixed liquor suspended solids concentration,

Q_s = sludge waste volumetric removal rate.

It should be noted that the rate constant for biodegradation is a pseudo first order rate constant in that it depends on the biomass concentration which is a system variable. The rate constant thus is valid only at a particular biomass concentration. Blackburn et al. (1985) reported that this model could be used successfully to predict the fate of organic compounds in small scale biological treatment systems. Barton (1986), and U.S. EPA (1987) also use models of this type for biological treatment systems. Kincannon et al. (1982) used a similar model considering biodegradation and stripping removal mechanisms. They found that reasonably good predictions of removal of priority pollutants, in combination, could be made using biodegradation and stripping rate

constants developed in single pollutant systems. Matter-Muller et al. (1980) used a similar model to describe removal of non-biodegradable VOCs in a biological treatment plant by sorption and stripping mechanisms. The use of this model depends on the availability of accurate kinetic constants for the removal mechanisms. This is a particularly difficult problem for biodegradation, where rate constants developed in the laboratory may not be applicable to full scale systems, or may be system specific and not translatable from one full scale system to another. Blackburn et al. (1985) suggested that more development may be required to predict the behaviour of organic chemicals in full scale treatment plants from experimental data.

The model used by Namkung and Rittmann (1986, 1987) to estimate VOC emissions from full scale diffused aeration activated sludge plants assumes saturation of the air bubbles leaving the aeration basin. In that case, the rate of removal by volatilization is given by,

$$r_V = Q_G H C \tag{62}$$

where

Q_G = volumetric air flow rate,
H = Henry's law constant,
C = VOC concentration in aeration basin,

Barton (1986) treats the problem of partial saturation of the air bubbles in a diffused air system by using the rate equation for volatilization given by Matter-Muller et al. (1981) and Roberts et al. (1984a) (see Section 2.3),

$$r_V = Q_G H(1 - \exp(-K_L aV/HQ_G))C \tag{63}$$

It should be noted that the models described above are steady state and not dynamic models. If hazardous organic pollutants are discharged intermittently to the treatment plant, and adequate equalization is not effected, the steady state models may be inadequate to predict plant performance. Such problems as alternating sorption and desorption of pollutants from the sludge, and acclimation of the microbial population, are not addressed in these simplified models. More complex dynamic models may be needed.

2.3 Field and Laboratory Volatilization Studies

2.3.1 Full Scale and Pilot Plant Plant Studies

A limited number of studies have been carried out to investigate emissions of VOCs to the atmosphere from full scale or pilot scale wastewater treatment plants.

2.3.1.1 Pilot Plant Studies

The U.S. EPA investigated the fate of volatile priority pollutants in a 35 gpm activated sludge pilot plant (Petrasek, 1981; Petrasek et al., 1983a). They found that significant fractions of most of the VOCs tested were removed by volatilization in the aeration basin.

Petrasek et al. (1983b) estimated stripping removal of 22 toxic organic compounds in an activated sludge pilot plant. They estimated a maximum stripping removal of 25% or greater for toxaphene, heptachlor, Arochlor 1254, and anthracene.

Matter-Muller et al. (1980) estimated the removal of some VOCs by volatilization in an activated sludge pilot plant. They reported removal efficiencies of p-dichlorobenzene and 1,2,4-trimethylbenzene by volatilization from 24 to 100%.

2.3.1.2. Municipal Treatment Plant Studies

Pellizzari and Little (1980) used a floating sampling chamber to measure the VOC concentrations in off-gases from grit chambers and aeration basins of two municipal wastewater treatment plants. They also measured the VOC emissions from the closed chamber of a pure oxygen treatment basin. Samples were collected on Tenax traps. The measured VOC emissions ranged as high as 540 µg/min ft^2 from the surface of the aerated process vessels. The compounds found in highest concentration were chloroform, toluene, dichloromethane, 1,2-dichloropropane, trichloroethylene, tetrachloroethylene, and 1,3-dichlorobenzene.

Lurker et al. (1982) measured emissions of chlorinated organic compounds from a large municipal activated sludge plant by collecting air samples in the vicinity of the grit chamber and aeration basins. They observed that compounds such as trichloromethane, tetrachloromethane, and tetrachloroethylene were released to the atmosphere from the grit chamber weir. Compounds such as hexachlorobicycloheptadiene (Hex-BCH), heptachlorobicycloheptene, and chlordene were reported to be emitted from wastewater by air stripping in the aeration basin. They estimated that over half of the Hex-BCH in the plant influent water was released to the atmosphere from the aeration basins.

Dunovant et al. (1986) measured the concentrations of 24 VOCs in the airspaces of three municipal wastewater treatment plants and reported concentrations as high as 35 ppm (v/v).

Wukasch et al. (1986) measured VOC emissions from two large municipal wastewater treatment plants. They estimated the total non-methane volatile organic emission rate from the two plants to be 42,000 kg/yr as methane.

Harkov et al. (undated) reported some VOC levels in the air at a large regional sewage treatment plant in New Jersey to be two orders of magnitude higher than typical VOC ambient air levels at urban/industrial sites in the state. They concluded from their study that sewage treatment plants can be a significant source of VOCs emitted to the air environment.

Namkung and Rittmann (1986, 1987) estimated the VOC emissions from two large municipal wastewater treatment plants in the Chicago area based on wastewater anlyses and a predictive model. They estimated removals of VOCs by volatilization ranged up to 83% for tetrachloroethylene. The total VOC emissions from the two plants are estimated to be about 10 and 42 tons per year. These estimates do not consider emissions from grit chambers and settling tanks. They estimated that the emissions from wastewater treatment plants make up less than 1% of the total hydrocarbon emission load in the Chicago area.

2.3.1.3 Industrial Treatment Plant Studies

Alsop et al. (undated) studied the fate of eight organic compounds in an industrial biological wastewater treatment plant at an organic chemical production facility. They found that 30% of the semivolatile compounds and 46% of the volatile compounds were lost to the air from the neutralization, primary clarification and equalization systems.

Thibodeaux et al. (1982) measured emissions of VOCs from pulp and paper wastewater treatment basins. Emissions of methanol, acetone, and acetaldehyde were detected. The total hydrocarbon flux rate was 26 to 37 kg/hectare d. A concentration profile technique was used to estimate VOC emission rates. Balfour et al. (1984) measured hydrocarbon emissions from some wastewater surface impoundments. Emissions of total non-methane hydrocarbons ranged from 0.8 to 49 kg carbon/hectare d. The measured emissions were compared with predictions of the model of Thibodeaux et al. (1982). In some of the cases examined, model predictions were not significantly different from measured values. In other cases the model predicted greater or lesser emission rates than measured.

Green and Eklund (undated) measured emissions of VOCs from a full scale industrial wastewater treatment system using floating sampling chambers and stainless steel cannisters for sample collection. They reported average emission flux rates from the aeration tank ranging up to almost 2000 μg/min m^2 for methane. The flux rates for toluene and acetaldehyde were 35 μg/min m^2 and 66 μg/min m^2, respectively.

Hwang (1985) compared different models for predicting VOC emissions from hazardous waste treatment facilities with measured emission rates.

Hwang and Thibodeaux (1983) proposed a method for measuring emission rates from large surface impoundments.

2.3.2 **Laboratory Studies**

In addition to the studies previously cited, other relevant laboratory investigations have been reported in the literature. Thibodeaux et al. (1972) and Thibodeaux (1974) proposed a method for measuring the fraction of volatile constituents in a wastewater and for determining the volatilization rates of volatile constituents. Thibodeaux and Millican (1977) tested 75 samples of industrial wastewater from a variety of industries and found that 64 contained detectable air-strippable fractions.

Mackay et al. (1979) proposed a method for measuring the Henry's law constants for hydrophobic pollutants. The H values for several compounds are given and compared with literature values. Satisfactory agreement between experimental and literature values was obtained. Using Mackay's method, Warner et al. (1980) determined H values for 41 priority pollutants.

Klecka (1982) examined the significance of volatilization and biodegradation for removal of dichloromethane in an activated sludge reactor. Based on laboratory tests and a theoretical model he suggested that for acclimated sludge the rate of biodegradation was 12 times faster than the rate of volatilization, and thus biodegradation may be the predominant removal mechanism of this compound.

Kincannon et al. (1983), Kincannon et al. (undated), Kincannon and Stover (1981), and Stover and Kincannon (1981) used a bench scale activated sludge system to determine the fate of 15 priority pollutants. For the compounds studied, stripping, biodegradation, or a combination of stripping and biodegradation were the most important removal mechanisms. Overall removals of all compounds were over 94%, and tetrachloroethane, 1,2-dichloropropane, 1,2-dichloroethane, and 1,1,1-trichloroethane were

removed almost totally by stripping. Confirming the work of Klecka (1982), dichloromethane was removed primarily by biodegradation.

Melcer and Bedford (1986) examined the fate of 4,6-dinitro-o-cresol (DNOC) in a bench scale activated sludge system. They found that DNOC losses by volatilization were insignificant and that the compound was removed primarily by biodegradation. Lurker et al. (1984) investigated the volatilization of hexachlorobicycloheptadiene (Hex-BCH) and trichloromethane in a bench scale activated sludge system. Stripping of both compounds was observed to follow first order kinetics. For both compounds an increase in aeration rate enhanced the stripping rate. For Hex-BCH the stripping rate was reduced by increasing the suspended solids concentration and enhanced by increasing the detergent concentration. The stripping rate of trichloromethane was unaffected by suspended solids and detergent concentrations.

Gurol and Nekouinaini (1985) found that the presence of phenols, alcohols, and organic acids in wastewater increase the gas-liquid interfacial area without reducing k_L and thus increase k_La. Surfactants also increased interfacial area but the accompanying reduction in k_L may result in a decrease in k_La. Khudenko and Garcia-Pastrana (undated) present a temperature correction relationship for mass transfer rates in gas absorption and stripping processes.

2.4 Conclusions

A substantial body of theoretical and laboratory work on volatilization has been reported in scientific and engineering literature. However, pilot plant and full scale plant investigations have only been reported to a limited extent. Some confirmation of theory in laboratory tests has been reported but the results do not appear to be consistent. Little, if any, confirmation of volatilization theory in full scale plant situations has been reported. There appears to be no general consensus among the investigators concerning the application of theoretical principles for predicting volatilization in field situations. In general, work on development of mathematical models for predicting the fate of VOCs in full scale wastewater treatment plants appears to be at a rudimentary stage.

3. MATERIALS AND METHODS

3.1 Off-Gas Sampling

Off-gas samples were collected from the influent end, centre, and effluent end of one aeration basin at each treatment plant. At all plants except Waterloo, off-gas samples were also collected at one location in one aerated grit chamber. Aerated grit chambers are not used at the Waterloo plant. All of the process vessels tested employed diffused aeration systems. Table 3.1 gives some pertinent design and operating data for the four plants. The gas samples were collected from 1.22 m square, floating, aluminum sampling chambers. The chambers were floated on the wastewater surface with the skirt submerged so that a 1.49 m^2 area of the water surface was isolated for sampling. During sampling the chambers were secured with ropes to maintain their position in the wastewater basin. In the grit tanks the sampling chambers were positioned, if possible, over the area of maximum aeration in order to obtain a measurable air flow rate. At the Lakeview plant, however, the air flow rate into the sampling chamber from the grit tank was too low to measure with the equipment used.

The aeration basins at each plant use different aeration patterns. Burlington Skyway uses a cross roll pattern. At Skyway the sampling chambers were placed over the areas of maximum aeration (directly over the aerators). This was done because it was expected that the maximum flux rate of VOCs would be in the areas of maximum aeration. The Highland Creek plant uses a fine bubble aeration system. In this plant the aeration appeared to be relatively uniform throughout the basin so sampling chamber placement was not as critical. The Lakeview plant has relatively narrow aeration basins and uses a spiral roll aeration pattern. The sampling chambers were placed in the centre of the basins as it was not possible to place the chambers directly over the aerators due to the high level of turbulence in the basins. At the Waterloo plant the aerators are in a square pattern in the centre of the basin at three locations along the basin length. A mechanical mixer is positioned at the centre of each

Table 3.1 Plant Operating and Design Data

PARAMETER	SKYWAY	HIGHLAND CREEK[1]	LAKEVIEW[2]	WATERLOO[3]
Grit Chambers				
Number	2	5	1	NA
Dimensions (WxLxD), m	6.1x12.2x6.4	4.0x18.3x4.0	6.4x27.4x3.9	NA
Volume, m^3/chamber	475.7	287	682.6	NA
Air Flowrate, m^3/min	4.3	2.8	10.4	NA
Aeration Basins				
Number	6	8	1	4
Dimensions (WxLxD), m	8x80x5	17.6x36x4.6	6.1x526.8x5	7.6x40.2x6.2
Volume, m^3/basin	3200	2896	16067	1913
Air Flowrate, m^3/min	852.5	238.4	2063.6	110.4
Diffuser Type	Coarse	Fine	Coarse	Coarse with Turbine Mixers
Air Flow Pattern	Cross Roll	Floor Cover	Spiral Roll	Complete Mix
Average Wastewater Flow Rate During Sampling Period, m^3/d	75,800	78,300	64,325	29,010
Hydraulic Residence Time, h	6.1	7.1	6.0	6.3
Aeration Rate, m^3 air/m^3 water	16	4.4	46	5.5

[1] old plant only
[2] plant 3 only
[3] old plant only

aerator square, although during the testing only the mixer at the effluent end of the basin was operating. Due to the high level of turbulence near the aerators, it was not possible to position the sampling chambers over the area of maximum aeration. One chamber was positioned in the vicinity of each aerator square, but out of the maximum area of turbulence.

During sampling, off-gas leaving the wastewater surface entered the sampling chamber and left the chamber through a 7.6 cm diameter vent stack. An off-gas sample was continuously drawn from the centre of the vent stack via a 6.4 mm diameter stainless steel sample line. The sample stream was passed through Tenax adsorbent traps where the VOCs were collected. The sample stream was drawn through each trap by the vacuum created by pumping water from a closed 5 L cylinder with a multihead peristaltic pump. The water pumped from each cylinder was collected and the volume was measured at the end of each sampling run to determine the volume of gas drawn through each trap. Figure 1 is a schematic flow diagram of the sampling system. Before each sampling run, the sample line was purged by drawing fresh sample through the line with a laboratory vacuum pump. Sampling was started by switching the three way solenoid valve to the sampling position and energizing the sampling pumps. Duplicate samples were collected at each location by splitting the sample stream through two traps in parallel. The samples were drawn through each trap by a separate vacuum cylinder and pump head. In this way the volume of gas drawn through each trap could be accurately measured. On the grit chamber sampling locations, one of the traps was fitted with a backup trap in series to check for breakthrough of VOCs from the lead trap. At Waterloo, the backup trap was placed on one of the traps at the influent end of the aeration basin. Since the highest concentrations of VOCs were expected at the influent ends of the plants, if trap breakthrough were to occur, it would be expected at those locations.

The sampling chambers were also used to measure the air flow rates from the process vessels at the beginning and end of each sampling run. The system used to measure air flow rates is shown schematically in Figure

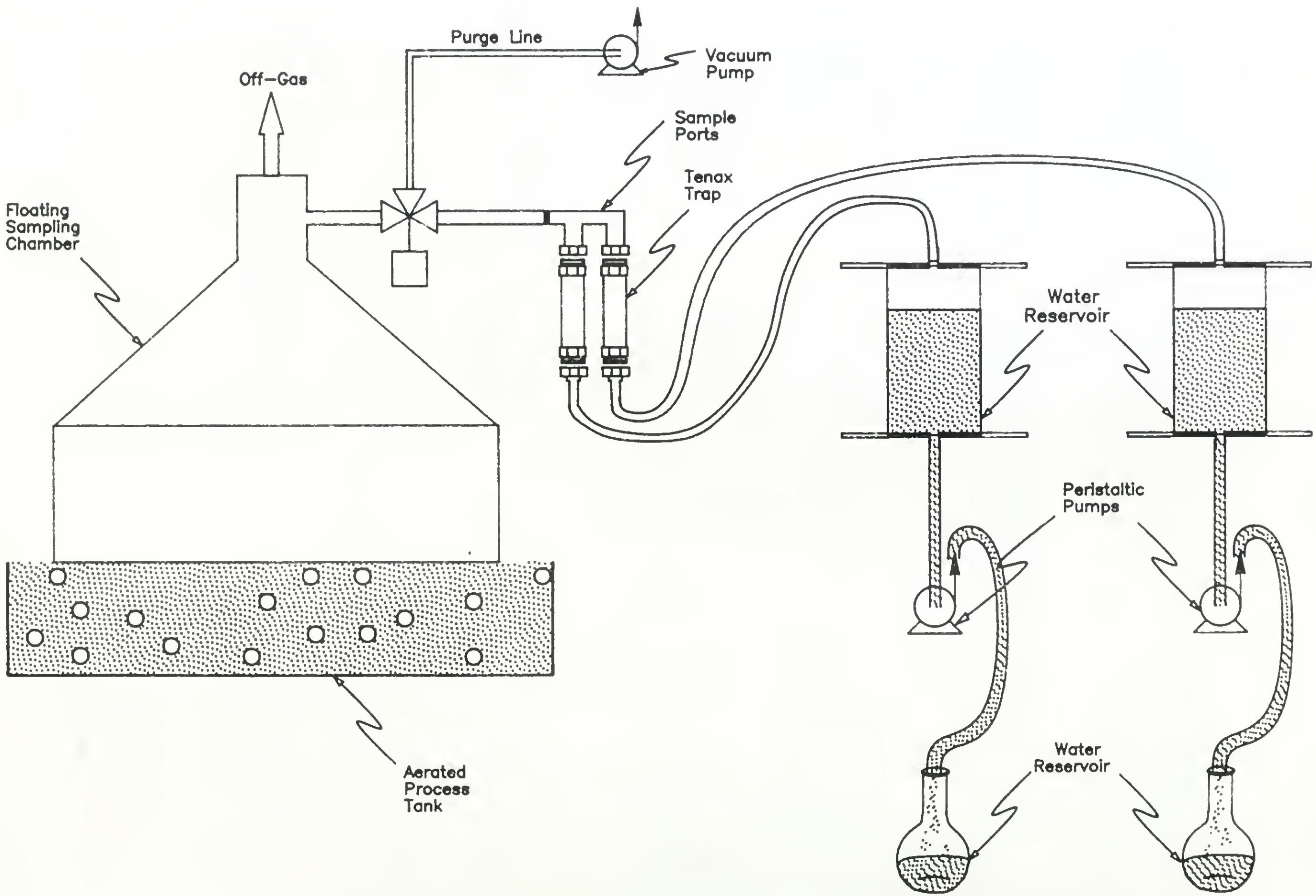

FIGURE 1: OFF-GAS SAMPLING SYSTEM

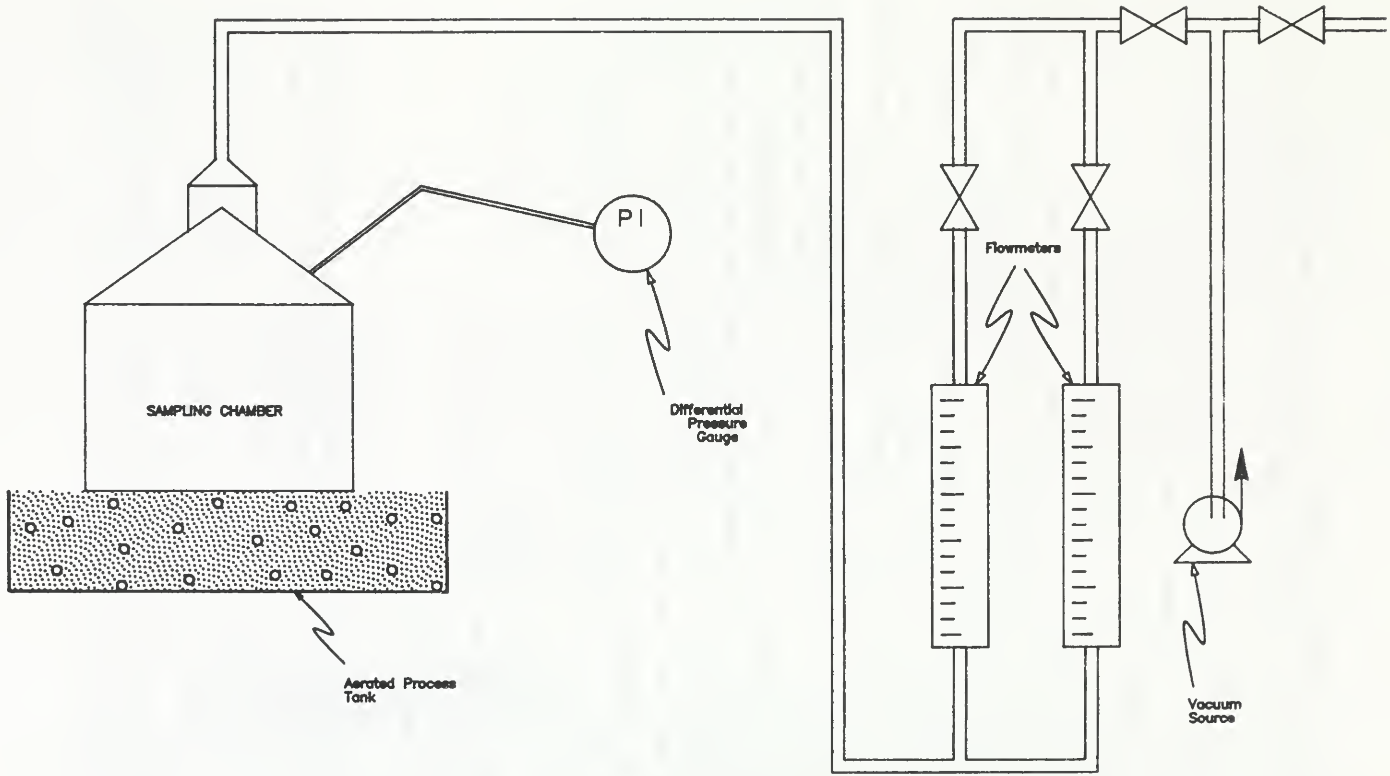

Figure 2: Off–Gas Flow Measurement System

2. During air flow measurements, the exit stack of the sampling chamber was connected to the flow measuring system by a 5 cm diameter flexible hose. The hose was connected to the inlet of either the low flow or high flow rotameter. The outlet end of the rotameters were connected to the suction side of a portable vacuum cleaner. The rotameter not in use was isolated by closing a valve on the appropriate rotameter outlet line. A flow control valve in the vacuum suction line was used to regulate the air flow from the sampling chamber. Another valve was used to control the quantity of outside air drawn into the vacuum cleaner. When the air flow rate from the sampling chamber was low it was necessary to provide additional outside air to the vacuum cleaner to prevent overheating of the unit. The outside air entered the vacuum suction line downstream of the rotameters. The interior of the sampling chamber was connected via 6.4 mm flexible tubing to a Magnehelic differential pressure gauge. The pressure gauge had a range of -2.5 to +2.5 cm of water. The gauge was connected to measure the pressure difference between the sampling chamber and the atmosphere. The air flow rate from the chamber was adjusted until this pressure difference was within 1.3 mm water of zero. At that point the air flow rate was read from the rotameter and recorded. When the chamber pressure was balanced with atmospheric pressure the flow rate out of the hood was equal to the normal flow rate with the chamber open to the atmosphere.

3.2 Analysis of Off-Gas Samples

3.2.1 Adsorbent Traps

Stainless steel sampling cartridges packed with 60/80 mesh Tenax GC were used for this study. The tubes were 175 mm long and 15 mm wide with Swagelok 316 stainless steel end fittings and caps. Tubes were packed with ca 2.5 g of Tenax which was prepared by overnight soxhlet extraction with methanol, followed by overnight soxhlet extraction with pentane. The Tenax was dried in a vacuum oven at 120°C for six hours and was sandwiched between plugs of silanized glass wool in the cartridges. The cartridges

were conditioned overnight by passing 100 mL/min ultra-high purity He through them at 280°C.

3.2.2. **Analysis**

An automated thermal desorption system (Wang Consultants) was interfaced with a Hewlett-Packard (HP) 5890 gas chromatograph with an HP mass selective detector (MSD). Cartridges were purged with He at 50 cc/min while being heated to 200°C during the desorption stage. Desorption time was 30 min. Volatiles were collected on a nickel trap maintained at -195°C with liquid nitrogen and filled with 60/80 mesh inert glass beads to increase trapping efficiency. A Perma Pure dryer (Perma Pure Inc., Farmingdale, N.J.) prior to the cold trap removed moisture and polar organics from the sample stream. The trap was flash heated to 150°C, delivering collected volatiles onto a 60 m DB-1 (0.32 mm ID, 1.0 micron film thickness) stationary phase capillary column. Eluents were analyzed by MSD and raw data were collected and stored for processing. Figure 3 is a schematic diagram of the analytical system.

Desorption conditions and GC program were as follows:

Thermal Desorption Unit	(Desorption Heating Block	: 200°C
	(Nickel Trap - minimum	: -195°C
	(- maximum	: 150°C
	(Desorption Time	: 30 min
	(He Purge Rate	: 50 cc/min
GC Program	(Initial Oven Temperature	: -60°C
	(Initial Hold Time	: 3.0 min
	(Oven Heating Rate	: 8°C/min
	(Final Temperature	: 280°C
	(Column Head Pressure	: 103 kPa

3.2.3. **Calibration**

The external standard calibration method was used. The calibration flask consisted of a 3.0 L spherical glass flask with dual sampling ports.

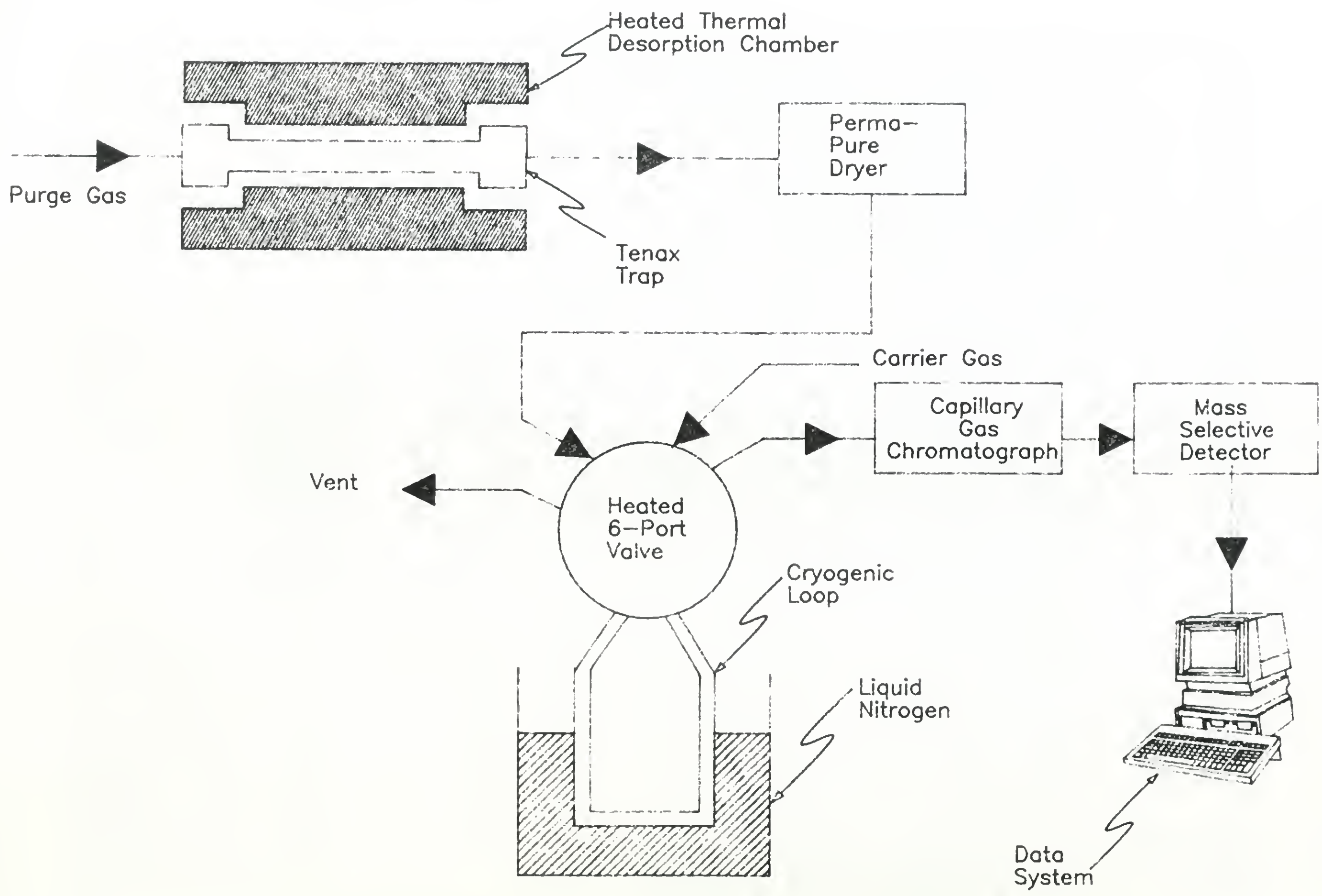

Figure 3: Analytical System

The ports were designed such that teflon stopcocks located in-line between the flask body and septum assemblies maintained the chamber integrity during intervals between sampling. Approximately 10 µL of a neat gravimetric standard of target compounds was added to the clean nitrogen filled flask. The flask was sealed and heated to between 150-170°C. At least 2.0 hours were allowed for vaporization, mixing of the sample and attainment of thermal equilibrium before aliquots of the gas were drawn off for calibration. For each target compound, a five level linear calibration plot was constructed. Calibration was rechecked with the neat standard mixture as described above on a weekly basis. An instrument performance reference standard of n-alkanes (Supelco, cat. no. 2-3444) was run daily. A response deviation of greater than ±10% resulted in a full instrument recalibration.

All trap preparation and off-gas analytical work was performed by Environment Canada, Pollution Measurement Division, Technology Development and Technical Services Branch, River Road Environmental Technology Centre, Ottawa, Ontario.

3.3 Wastewater Sampling and Analysis

Wastewater samples were taken in the vicinity of each sampling chamber at the beginning and end of each sampling run. Duplicate samples were collected in 60 mL amber, septum top bottles. The samples were refrigerated at 4°C during storage and transported to the analytical laboratory. All wastewater samples were analyzed by Barringer Magenta Ltd., Rexdale, Ontario, using purge and trap gas chromatography/mass spectroscopy. A modified version of U.S. EPA method 624 was employed, using 25 mL sample aliquots and a 60 m capillary chromatograph column. The mass spectrometer was a Finnigan 1020 OWA with a 1050 software upgrade. Approximately 10% of the samples were analyzed in duplicate as a quality assurance check. In addition, some blank and spiked samples were also analyzed.

4. RESULTS AND DISCUSSION

4.1 Off-Gas Concentrations

4.1.1 General

Off-gas VOC concentration data for the four plants are given in Appendix A. In all the tables in the appendices, the designation "NA" means "not detected" for analytical data and "not applicable" for calculated values. Tables A1 - A15 summarize the measured concentrations at each sampling location along with the average concentrations for the entire sampling period. These tables show the temporal variations in concentratration at each point in the process. Tables A16 - A31 report the concentrations at all sampling points in each plant on a given day. These tables show the variations in concentration from point to point in the plant. Off-gas concentrations were determined by dividing the measured quantity of each VOC on the adsorbent trap by the measured gas sample volume. Review of the data indicates that, of the 36 compounds analyzed, only two were not detected in any of the samples. The two compounds not found are trans-1,2-dichloroethylene and dibromomethane. A few compounds were detected at concentrations greater than 1000 $\mu g/m^3$, and several were detected above 100 $\mu g/m^3$. Based on the average concentrations from the grit chambers (the influent end of the aeration basin for Waterloo), the Highland Creek plant had the highest total VOC concentration, with Skyway, Lakeview, and Waterloo following in descending order.

The VOCs emitted from grit chambers at the highest concentrations were: dichloromethane, toluene, 1,1,1-trichloroethane, m,p-xylene, 1,3,5-trimethylbenzene, 3-ethyltoluene and 4-ethyltoluene. Table 4.1 summarizes the average total VOC concentration in the off-gas at each location from each plant. The reported total concentrations are summations of the average VOC concentrations of the measured compounds. It is recognized that other compounds which were not analyzed for could also be present in the off-gases. In general, there is little change in total VOC

Table 4.1 Average Total VOC Concentration in Off-Gas

Plant	VOC Concentration ($\mu g/m^3$)			
	Grit Chamber	Aeration Basin		
		Influent	Midpoint	Effluent
Highland Creek	6500	6300	5500	5800
Skyway	4900	3600	1500	1500
Lakeview	1400	3200	1100	500
Waterloo	-	300	230	300

off-gas concentration through the process sequence at Highland Creek and Waterloo. At Skyway and Lakeview, the total VOC off-gas concentrations generally appear to decrease through the treatment sequence. In general, the observed off-gas VOC concentration range is similar to that reported by Pellizzari and Little (1980) for two municipal wastewater treatment plants in North Carolina.

4.1.2 **Highland Creek**

At Highland Creek, six compounds were detected at concentrations above 1000 $\mu g/m^3$ in at least one sample. The six compounds are: dichloromethane, 1,1,1-trichloroethane, toluene, 4-ethyltoluene, 3-ethyltoluene, and 1,3,5-trimethylbenzene. The 1,1,1-trichloroethane was found in highest concentration and the concentration did not appear to be significantly reduced as it passed from the grit chamber through the aeration basin. The concentration of dichloromethane appeared to diminish slightly through the treatment process. The toluene concentration appeared to decrease from the influent end to the effluent end of the aeration basin. The other high concentration compounds decreased in concentration between the grit chamber and the aeration basin but not across the aeration basin. The total off-gas VOC concentration decreased slightly in the downstream direction in the aeration basin (Table 4.1). The lower air flow rate at Highland Creek results in a smaller loss of VOCs by stripping and thus less change in concentration along the aeration basin.

4.1.3 Skyway

Dichloromethane, toluene, and m,p-xylene were detected at concentrations above 1000 μg/m^3 in some off-gas samples at the Burlington Skyway plant. The dichloromethane concentration in the off-gas appears to remain relatively constant through the treatment process. The off-gas concentrations of toluene and the xylenes decrease in the downstream direction along the treatment process. The total off-gas VOC concentration decreases substantially downstream along the treatment process (Table 4.1). This suggests that VOCs are removed to a substantial extent in the process and that the mixing pattern tends toward plug flow. Only two days of off-gas sampling at the effluent end of the aeration basin are reported due to equipment problems during the other two days.

4.1.4 Lakeview

Only dichloromethane was detected at a concentration above 1000 μg/m^3 in the off-gas from the Lakeview plant. In general, the off-gas concentrations observed at Lakeview were lower than those found at Highland Creek and Skyway. Compounds detected at concentrations greater than 100 μg/m^3 in at least one sample are 1,1,1-trichloroethane, toluene, tetrachloroethylene, o-xylene, m,p-xylene, 4-ethyltoluene, 2-ethyltoluene, and 1,2,4-trimethylbenzene. The off-gas concentrations of all of these compounds, as well as the total VOC concentration (Table 4.1), appear to decrease in the downstream direction along the treatment process. This is probably due to the long, narrow aeration basins which approximate plug flow conditions and suggests that substantial VOC removal occurs in the process.

4.1.5 Waterloo

At the Waterloo plant none of the VOCs were observed at concentrations greater than 1000 μg/m^3 in any off-gas samples. Dichloromethane and tetrachloroethylene were detected at concentrations above 100 μg/m^3 in

some samples. In general, the VOC concentrations in the off-gases at Waterloo were significantly lower than at the other plants. The off-gas concentrations at the three locations in the aeration basin appear to be essentially the same for samples taken simultaneously and also for the total VOC concentration (Table 4.1). This is probably the result of mixing in the aeration basin. The smaller basins at Waterloo are likely to be closer to complete mix systems than the basins at the other plants which probably are closer to plug flow systems.

4.1.6 **Quality Assurance**

Three types of tests were run to ascertain the quality of the off-gas analytical data: analysis of blanks, precision tests; and breakthrough tests. Blank traps containing clean Tenax were analyzed in the same manner as the sample traps. Table B1 in Appendix B shows the results of these analyses. The quantity of compound found on the sample traps was adjusted in each case by subtracting the concentration of that compound found on the blank for the appropriate plant. For Lakeview, where no blank was available, an average of all the other blanks was used. It can be seen from Table B1 that the blank traps show some background contamination. It is known that clean Tenax releases a number of compounds during the desorption process, which may account for the observed results (Chan et al., 1986; Ligocki and Pankow, 1985; Pellizzari et al., 1984).

Approximately 25% of the off-gas samples were run in duplicate to test the precision of the measurements. At each sampling chamber, the off-gas was drawn through duplicate adsorbent traps. This provided a replacement trap in case of analytical problems and also for duplicate analysis. Tables B2 - B16 in Appendix B give the mean, standard deviation, and coefficient of variation for the duplicate analyses. It can be noted from the data that the coefficients of variation for the lower concentrations tend to be more variable and generally higher than for the higher concentration compounds. Although the absolute error is lower for the low concentrations, the percent error tends to be greater. This result is to

be expected, particularly at concentrations near the detection limit of the analytical instruments. For the off-gas samples at Skyway, Lakeview, and Waterloo the coefficients of variation for the duplicate samples are generally less than 10%, indicating good precision for the sampling and analytical methods. The precision test data for Highland Creek indicate much more variability and generally less precision than that of the other plants. The precision appears to improve somewhat in the downstream direction. A possible explanation for the greater error in the Highland Creek samples is the fact that the samples were more highly contaminated. In addition to containing more of the identified VOCs, the Highland Creek samples contained a significantly greater quantity of unidentified compounds. A review of representative chromatograms for the four plants (Figures 4 - 7) gives an indication of the greater level of contamination in the Highland Creek samples. The loss of precision probably results because the selected VOCs must be identified and quantified within a more contaminated solution.

To obtain an indication of the overall error in the off-gas concentration measurements, pooled, or combined, coefficients of variation were computed from the duplicate data using the method described by Davies and Goldsmith (1972). Data for compounds which were not detected in either or both of the duplicate samples were not included in calculations of the pooled coefficients of variation. The coefficients of variation were pooled for each compound across each plant and across all four plants and also across each sampling location. In addition, pooled coefficients of variation were estimated across all measured compounds at each plant. Finally, an overall pooled coefficient of variation was estimated for all compounds and all samples. The estimated pooled coefficients of variation are given in Tables B21 and B22. The overall coefficient of variation for all compounds and all samples is 21.5%. The pooled coefficients of variation for all compounds at a single plant range from 8.4% at Skyway to 31.2% at Highland Creek. The coefficients of variation pooled across all compounds and all plants at a particular sampling location range from 9.9% for aeration basin effluent samples to 39.1% for grit chamber samples.

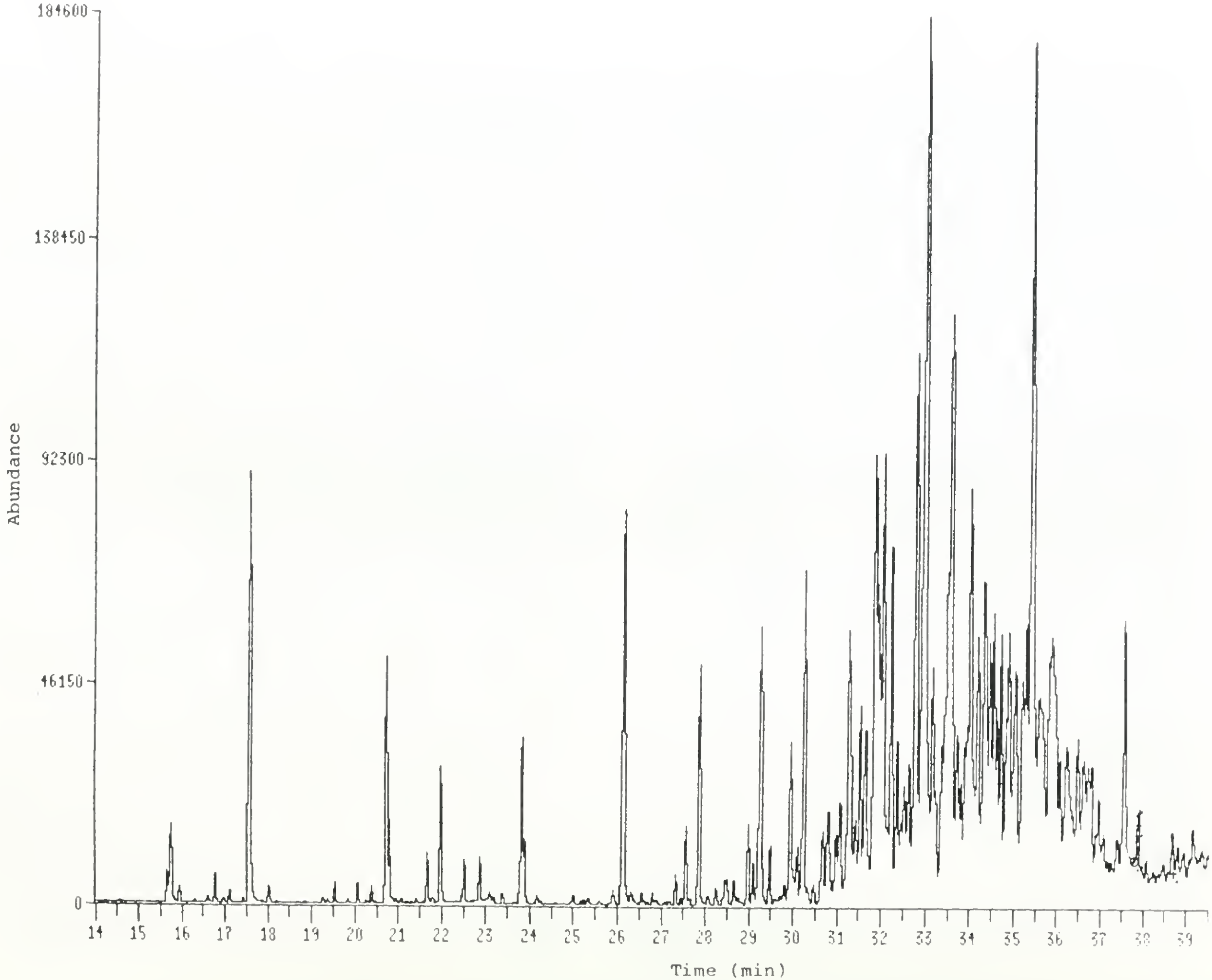

FIGURE 4. Sample Chromatogram - Burlington Skyway Grit Chamber

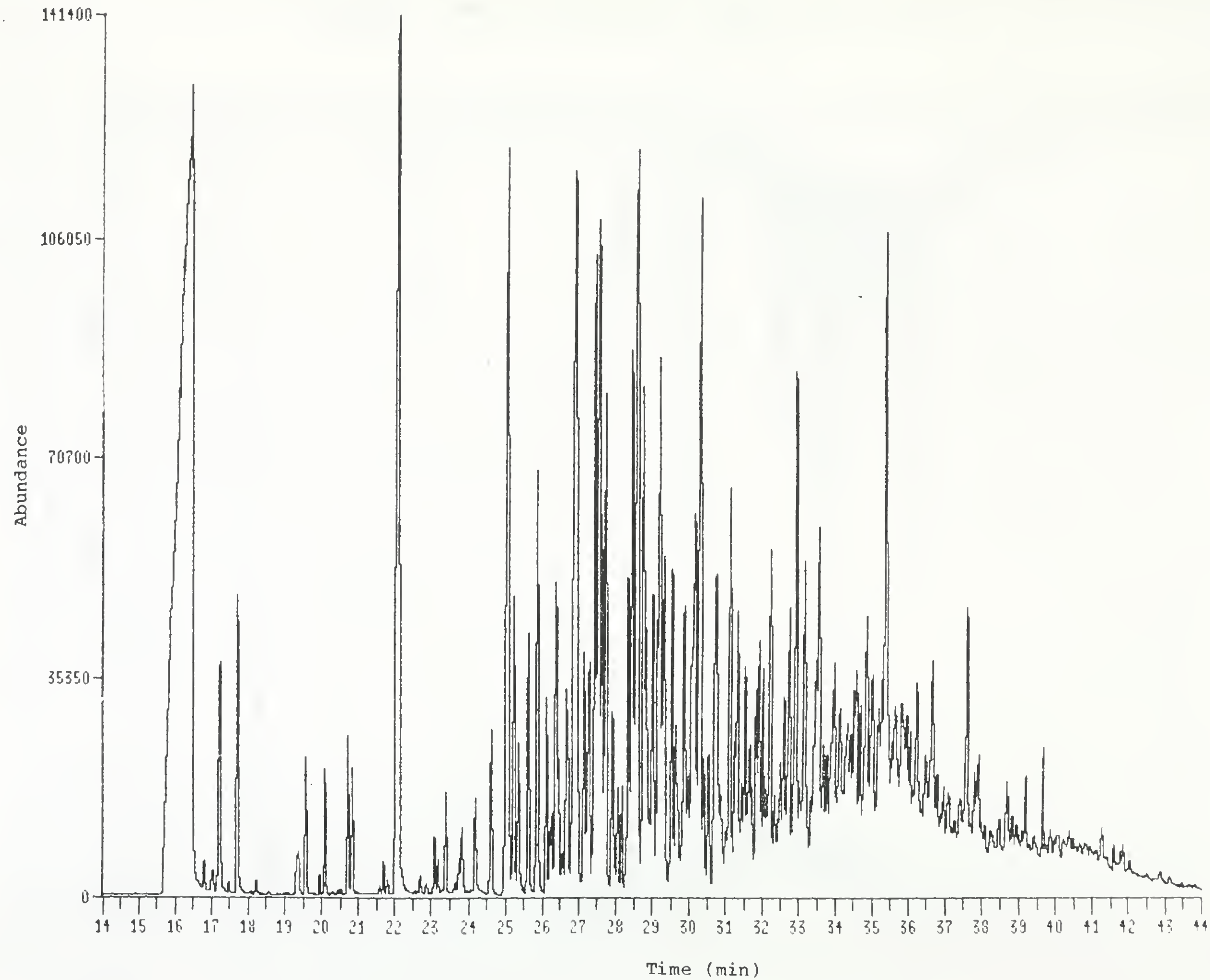

FIGURE 5. Sample Chromatogram - Highland Creek Aeration Basin

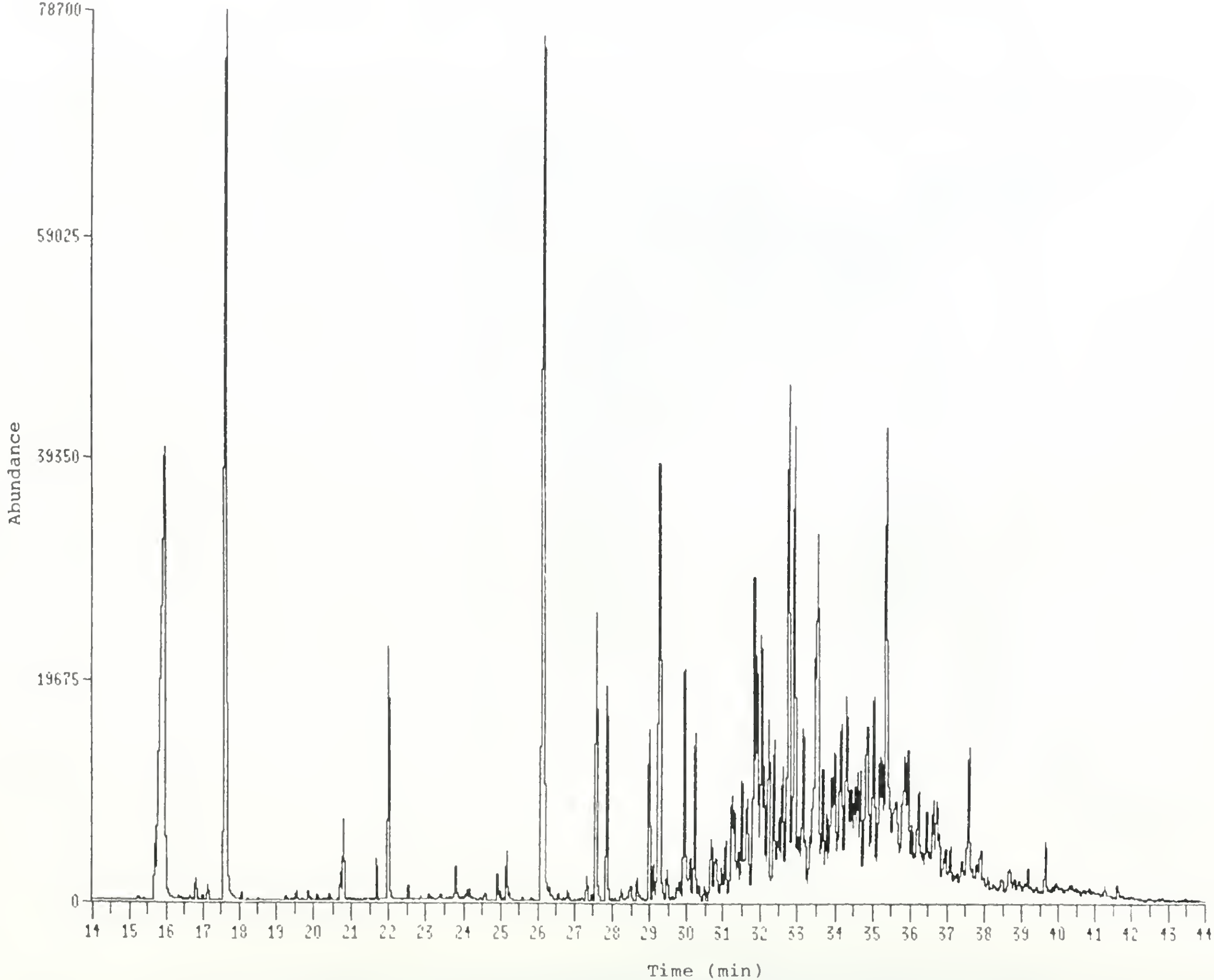

FIGURE 6. Sample Chromatogram - Lakeview Aeration Basin

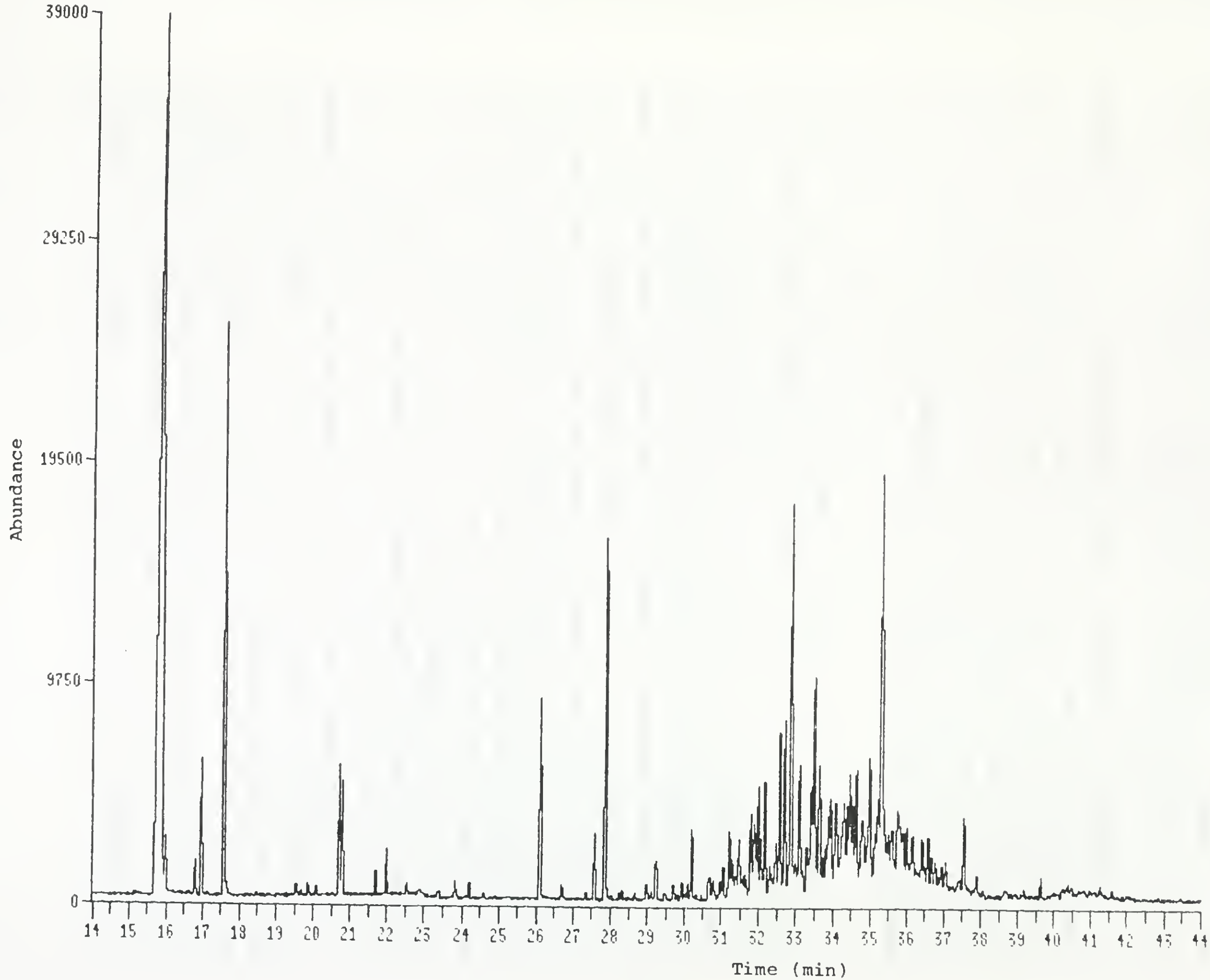

FIGURE 7. Sample Chromatogram - Waterloo Aeration Basin

These data suggest that the precision of the off-gas concentration measurements is lower for more contaminated samples (e.g. Highland Creek, or grit chambers in general) than for less contaminated samples (e.g. Skyway or Waterloo, or aeration basin effluents in general).

In addition to analysis of duplicates, tests for trap breakthrough were carried out. The breakthrough tests were conducted by placing a second trap in series with, and downstream of, the primary trap. The breakthrough tests were all conducted at the most upstream sampling location in each plant. Since the highest concentrations were expected at these points it seemed likely that if breakthrough were to occur it would occur there.

Breakthrough data are given in Tables B17 - B20. For the Skyway, Lakeview, and Waterloo plants, breakthrough was not observed for most compounds. It is not known why the sample for day 4 at Skyway showed apparent breakthrough of small fractions of a number of compounds while the previous samples did not. This behaviour could be the result of a small leak in the connection between the two traps, which would cause contaminated air to be drawn into the backup trap. At Lakeview, one of the samples showed apparent breakthrough of 4-ethyltoluene and 2-ethyltoluene, while the other samples showed no breakthrough. At Waterloo, three samples showed apparent breakthrough of toluene. No other evidence of breakthrough was observed. It is not known whether the observed apparent breakthrough of these compounds represents actual breakthrough or is the result of artifacts released by the Tenax adsorbent, or some other problem.

The breakthrough test results at Highland Creek are somewhat inconsistent with the results at the other plants. While the apparent percent breakthrough for most of the compounds is small, a few compounds were found only on the backup trap. While this is theoretically possible if the compound appeared only at the beginning of the sampling run, it does not seem likely. These results may be artifacts caused by the high level of contamination in the Highland Creek samples. Based on the overall

results of the breakthrough tests, it appears that, under the test conditions, breakthrough was not a significant problem.

Although no tests for the accuracy of the analytical method were carried out as part of this project, recovery tests for the VOCs identified in this work have been previously conducted by Environment Canada's River Road Environmental Technology Centre using similar traps (Dann, undated). These tests indicate that recoveries of a large number of VOCs in the range of 80 - 100% are attained with the methods employed in this project. Similar results were achieved in subsequent recovery tests of six VOCs carried out by Environment Canada's Wastewater Technology Centre (MacGillivray, 1988).

4.2 Estimated Emission Rates

Estimates of the VOC emission rates from the four treatment plants are given in Tables E1 - E4 in Appendix E. The estimates are based on the measured VOC off-gas concentrations and plant air flow data. The air flow rates used for the estimates are the measured or estimated air flow rates obtained from plant operating records and are reported in Table 3.1. Although air flow rates into the sampling chambers were measured during the testing, it is difficult to use these data to estimate overall air flow rates. The sampling chamber air flow data represent the air flow at a limited number of discrete points in the process vessels. Since the air flow is generally not uniform over the surface of the vessels, it was felt that average air flow rates could not be reliably determined from these limited data. It was therefore decided to base the emissions estimates on plant operating data. Air flow rates measured during the test runs are given in Appendix C and are summarized in Table 4.2. The emission rate estimates were computed by multiplying the average off-gas VOC concentrations by the appropriate average air flow rates. The concentrations were averaged both temporally and spatially. It is assumed that the measured off-gas concentrations are representative of the entire off-gas flow. Since the points of maximum aeration were measured at Skyway, this

Table 4.2 Measured Sampling Chamber Air Flow Rates

	Average Sampling Chamber air Flow Rate (m^3/h)*			
	Grit	Aeration Basin		
Plant	Chamber	Influent	Midpoint	Effluent
Skyway	3.4 (6.6)	45.5 (2.5)	33.8 (8.8)	45.2 (4.1)
Highland Creek	29.1 (1.3)	5.4 (0.0)	2.9 (0.0)	4.4 (7.6)
Lakeview	1.0	5.2 (60)	6.0 (79)	5.5 (82)
Waterloo		2.0 (0.0)	3.9 (12)	3.5 (5.3)

*Numbers in parenthesis are coefficients of variation (%).

assumption is probably reasonable for that plant. At Highland Creek, the air flow was reasonably uniform over the surface of the aeration basin, so that the assumption is probably also valid there. At Lakeview and Waterloo, it was not possible to position the sampling chambers over the points of maximum air flow. Thus, for those plants, the assumption may not be valid. The estimated flux rates were obtained by dividing the total emission rates by the vessel surface area computed from the dimensions given in Table 3.1. Although only one grit chamber and one aeration basin were tested at each plant, the estimates include the emissions from the other identical vessels. It is assumed that emissions from the tested vessels are representative of emissions from similar vessels operating in parallel. At Highland Creek and Waterloo, part of the plant employs mechanically aerated aeration basins. These processes are not included in the emissions estimates. The total VOC emissions estimates for each plant are given in Table 4.3. As a basis for comparison of the different plants, the emissions estimates have been normalized by computing the total emissions per unit volume of wastewater treated. These estimates are summations of the individual compound emissions estimates given in Tables E1 - E4. It should be noted that these estimates do not include any contributions from processes other than grit chambers and aeration basins. As noted above, emissions from mechanically aerated vessels are not included. Compared with estimated VOC emissions in Ontario from other sources (Wong et al., 1986; Yap, 1988), the emissions of the measured VOCs

Table 4.3 Total VOC Emissions Estimates

Plant	Total Estimated Emissions	
	Total(g/d)	Per Unit WW Vol. ($g/10^3 m^3$)
Lakeview	4800	75
Highland Creek	4100	53
Skyway	2700	29
Waterloo	44	2

from the four treatment plants are estimated to contribute less than 0.1% of the total VOC emissions in their respective areas. The differences in the VOC emissions per unit volume of wastewater treated probably reflect the different levels of industrial discharge into the four treatment plants.

Since VOC emissions from a process are related to the aeration rate, it is of interest to examine the effect of aeration rate on VOC emissions. Table 4.4 gives the aeration rate for each plant in m^3 of air per m^3 of wastewater based on information from plant operating records. The percent of total VOCs entering the plant in the wastewater which are emitted to the atmosphere is also given for each plant. The Highland Creek plant which uses fine bubble diffusers, has the lowest aeration rate and also the lowest fractional removal of VOCs by stripping. Lakeview and Skyway, which employ higher aeration rates than Highland Creek and Waterloo, strip substantially higher fractions of the input VOCs to the atmosphere. The high fraction of stripping at Skyway is largely due to the exceptionally high concentrations of dichloromethane and toluene in the off-gas samples. If these compounds are eliminated, the VOC removal by stripping at Skyway is 34% which is comparable to that at Lakeview (38%), (see Table 4.5).

Since there are not substantial variations in hydraulic retention times in the aeration basins at the four plants (Table 3.1), the effect of that variable on VOC stripping could not be assessed.

Table 4.4 Voc Emissions Compared With Aeration Rates

Plant	Aeration Rate (m^3 air/m^3 WW)	Percent of VOC Input Emitted to Atmosphere
Lakeview	46	38
Skyway	16	73
Waterloo	5.5	17
Highland Creek	4.4	11

4.3 Wastewater Concentrations

4.3.1 General

Wastewater samples were taken at the location of each off-gas sampling chamber at the beginning and end of each off-gas sampling run. The results of analysis of the wastewater samples are given in Tables F1 - F35 in Appendix F. Tables F1 - F15 give the analysis of all samples at the same location and show the temporal variations of VOC concentrations. Tables F16 - F35 give the analysis of samples at all locations within a plant on the same day and show the spatial variations. The spatial variations of wastewater and off-gas VOC concentrations for selected compounds are shown graphically in Figures 8 - 19. The wastewater analysis includes some compounds in addition to those for which off-gas measurements were made. These data are included at the end of the tables, separated from the other compounds by a horizontal line.

4.3.2 Skyway

At Skyway the average concentrations of all VOCs at all locations were less than 15 µg/L and the concentrations of the majority of compounds were less than 5 µg/L. For most of the compounds, the concentration decreased in the downstream direction through the treatment plant (e.g. Figure 10).

However, the concentrations of dichloromethane and toluene seemed to exhibit little spatial variation. This is consistent with the lack of spatial variation in the off-gas concentration for dichloromethane but inconsistent with the off-gas results for toluene (Figures 8 and 9).

4.3.3 Highland Creek

The concentrations of the VOCs at Highland Creek were significantly higher than those observed at Skyway, consistent with the higher off-gas concentrations. It is interesting to note that on day 5 the concentration of trichloroethylene was observed to be over 1000 μg/L in the grit chamber, although on the previous four days the concentration was less than 4 μg/L. Perhaps this represents a chemical spill or intermittent industrial discharge. Concentrations of 1,1,1-trichloroethane above 100 μg/L were also observed. For a majority of the compounds, the concentration decreased significantly in going from the grit chamber to the aeration basin. Except for toluene (Figure 12), and trichloroethylene on day 5, which decreased in the downstream direction, the concentrations of most compounds did not exhibit great spatial variation in the aeration basin (e.g. Figures 11 and 13).

4.3.4 Lakeview

In general, at Lakeview, the compounds detected at the highest concentrations in the off-gas (dichloromethane, toluene, m,p-xylene) appeared at the highest concentrations in the wastewater. Although some of the VOCs were found at higher concentrations in the wastewater than at Skyway, the off-gas concentrations were higher at Skyway. This may have been the result of the lower aeration rate at Skyway (see Table 4.4). The concentrations of the major compounds appeared to decrease in the downstream direction which is consistent with the results of the off-gas measurements (Figures 14 - 16). The increase in off-gas VOC concentrations from the grit chamber to the aeration basin influent is probably due to the very low air flow in the grit chamber.

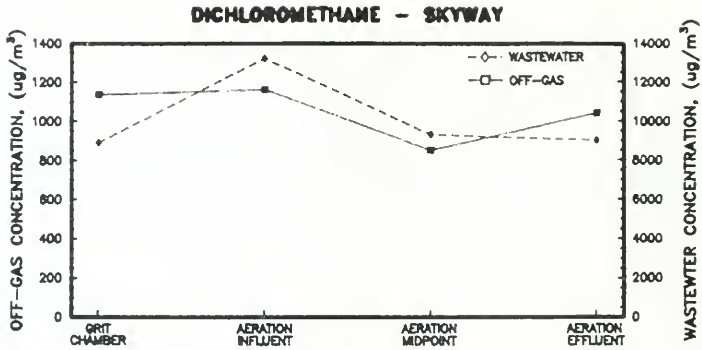

Figure 8: Off-Gas and Wastewater Concentrations versus Sample Location

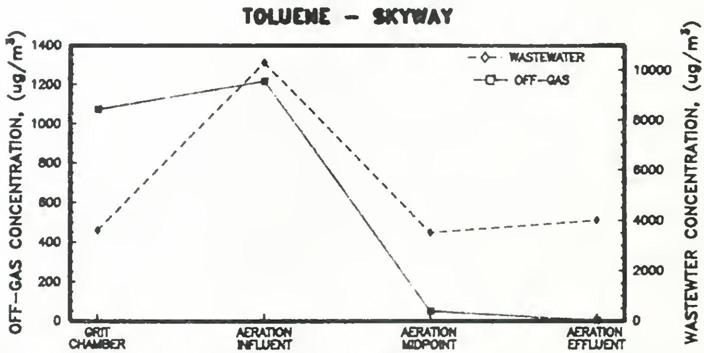

Figure 9: Off-Gas and Wastewater Concentrations versus Sample Location

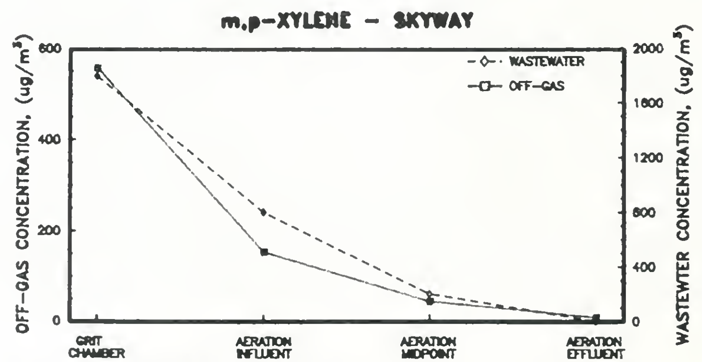

Figure 10: Off-Gas and Wastewater Concentrations versus Sample Location

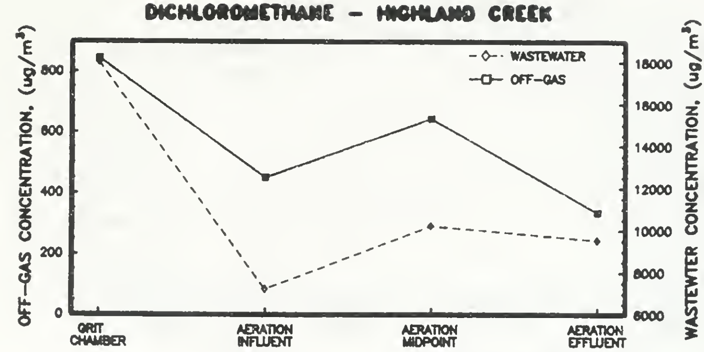

Figure 11: Off-Gas and Wastewater Concentrations versus Sample Location

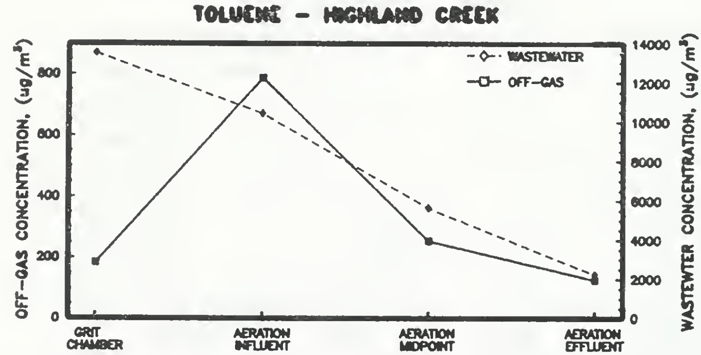

Figure 12: Off-Gas and Wastewater Concentrations versus Sample Location

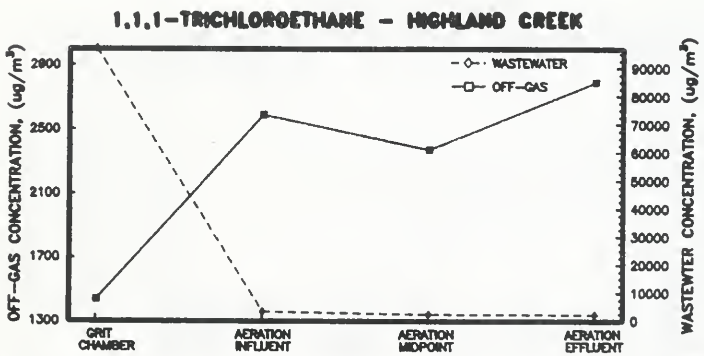

Figure 13: Off-Gas and Wastewater Concentrations versus Sample Location

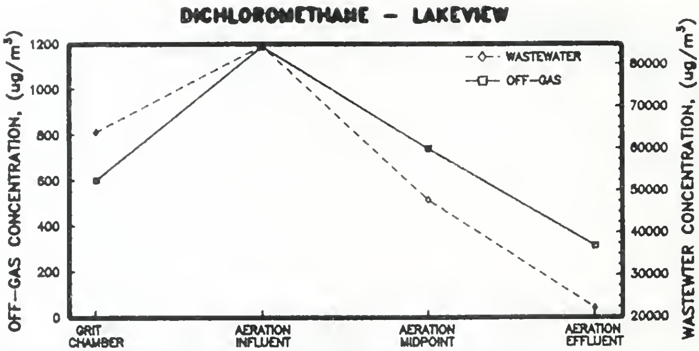

Figure 14: Off-Gas and Wastewater Concentrations versus Sample Location

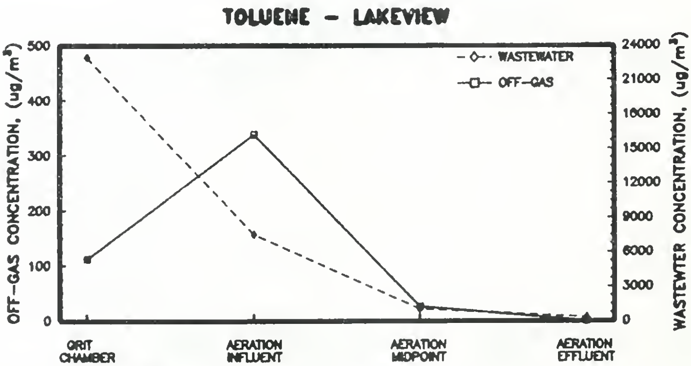

Figure 15: Off-Gas and Wastewater Concentrations versus Sample Location

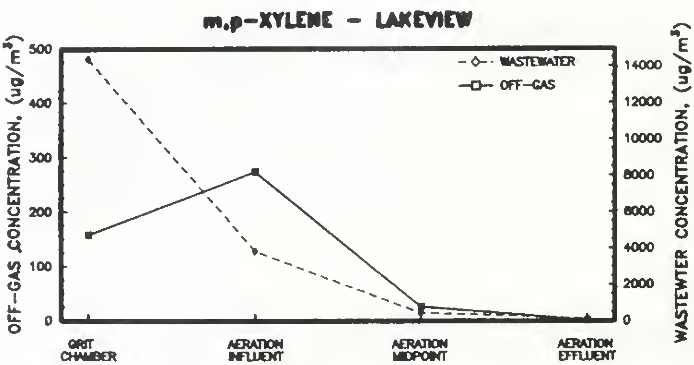

Figure 16: Off-Gas and Wastewater Concentrations versus Sample Location

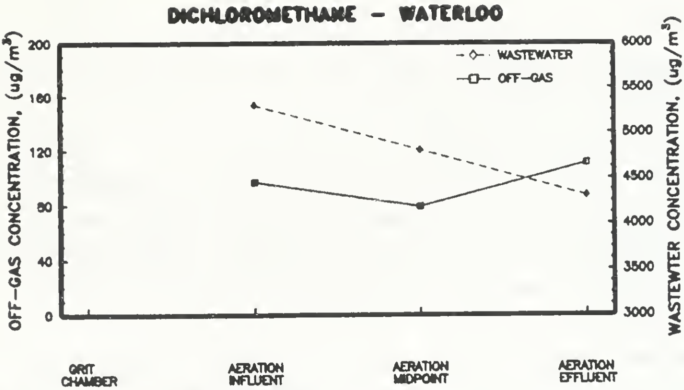

Figure 17: Off-Gas and Wastewater Concentrations versus Sample Location

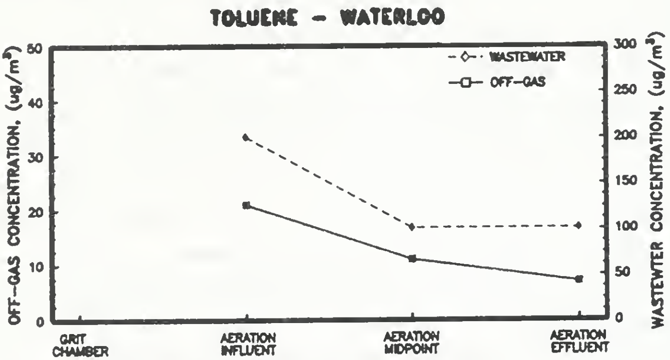

Figure 18: Off-Gas and Wastewater Concentrations versus Sample Location

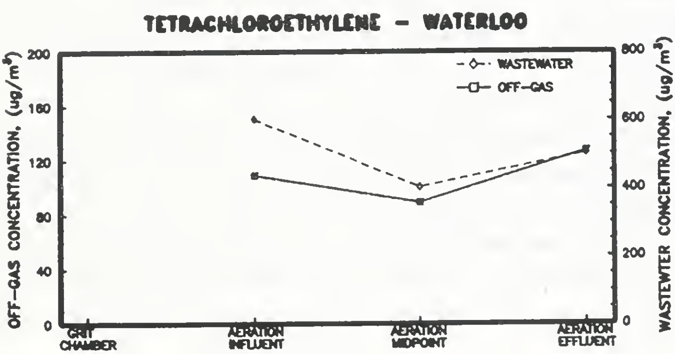

Figure 19: Off-Gas and Wastewater Concentrations versus Sample Location

4.3.5 Waterloo

At Waterloo, only dichloromethane was detected at concentrations greater than 5 µg/L. In general, the wastewater VOC concentrations were substantially lower than for the other plants. The VOC concentrations did not exhibit substantial spatial variations which is consistent with the off-gas concentration observations (Figures 17 - 19).

4.3.6 Quality Assurance

Analysis of duplicate samples was carried out to determine the precision of the analytical method. Approximately 10% of the samples were analyzed in duplicate. The results of the duplicate analyses are given in Tables G1 - G11 in Appendix G. The mean, standard deviation, and coefficient of variation are given for each duplicate pair. Analysis of reagent and field blanks was also carried out. Reagent blanks consisted of distilled, activated carbon filtered water. The field blank contained the same water shipped to and from the field site in a standard, sealed sample bottle. The results of analysis of the blanks are given in Table G12. As a further quality assurance test for method accuracy, some wastewater samples were spiked with selected VOCs and analyzed along with unspiked duplicate samples. The results of the spiking tests are given in Table G13.

Review of the precision test data indicates that the coefficients of variation are less than 20% for the majority of compounds detected at concentrations of 1 µg/L or greater. Many of the lower concentrations reported are close to or below the normal minimum detection limit for the compound. In these cases greater error is expected. Pooled coefficients of variation for the wastewater analyses were estimated as previously described for off-gas analyses (Section 4.1.6). These estimates are given in Tables G14 and G15. The overall coefficient of variation pooled across all compounds and all samples is 21.8%. The coefficients of variation pooled across all compounds at a single plant range from 17.9% (Waterloo) to 27.5% (Highland Creek). The coefficients of variation pooled across all

compounds and all plants at a particular sampling location range from 16.6% (aeration basin effluent) to 25.6% (aeration basin influent).

In general, the reagent blanks appeared to be clean except for small quantities of dichloromethane and in one case toluene. These are considered to be normal results for analyses of this type. The field blank showed small quantities of chloroform and benzene. This possibly resulted from contamination of the sample bottle during storage, handling, and shipping. The spiking tests show recoveries of the selected VOCs from 44.8% to 111%. The highest recovery was observed for dichloromethane and the lowest for ethylbenzene. In general, the recoveries decreased with decreasing vapour pressure and decreasing water solubility of the compounds. The reason for the low recovery of some of the compounds is not known. Some loss may be the result of sorption on to solids in the sample. This result suggests that the wastewater concentrations for some of the VOCs may actually be higher than the reported values.

4.4 Mass Balances

VOC mass balances were computed for each treatment plant using the wastewater and off-gas data together with plant operating data provided by the plant operators. Mass balance information is given in Tables 4.5 - 4.8. Each VOC input is a flow weighted average based on grit chamber wastewater VOC concentrations. For Waterloo, the input data are based on aeration basin influent concentrations. Effluent loadings are flow weighted averages based on aeration basin effluent concentrations. VOC air emissions were estimated as described in Section 4.2. Only compounds which were detected in the influent are included in the mass balances. In computing percent removal, compounds not detected were taken to be at zero concentration. It should be noted that the wastewater sampling was not originally intended to be used for mass balances and therefore the mass balances should only be taken as rough estimates. Wastewater samples were all single grab samples taken once a day at each location. Because the Waterloo aeration basin is probably close to a complete mix system the

Table 4.5 Estimated VOC Loadings and Emissions - Skyway WPCP

COMPOUNDS	WASTEWATER VOC LOADINGS (g/d)[1] INPUT	EFFLUENT	OVERALL % REMOVAL[2]	VOC AIR EMISSIONS (g/d)	% VOC STRIPPED
Dichloromethane	660.2	652.6	1	1245.7	189
1,1-Dichloroethane	5.8	19.5	-235	4.3	74
Chloroform	286.8	53.5	81	209.8	73
1,1,1-Trichloroethane	83.5	9.7	88	65.8	79
Benzene	11.5	ND	100	3.7	32
Dibromomethane	5.8	ND	100	ND	NA
Bromodichloroethane	2.7	ND	100	16.5	617
Trichloroethylene	131.0	10.1	92	37.9	29
Toluene	279.1	300.9	-8	516.7	185
Tetrachloroethylene	119.0	18.2	85	47.7	40
Ethylbenzene	19.2	ND	100	28.0	146
m,p-xylene	134.1	1.3	99	83.0	62
o-xylene	147.0	1.3	99	42.3	29
Cumene	34.2	6.8	80	15.0	44
Propylbenzene	83.7	12.2	85	35.6	43
3&4-Ethyltoluene[3]	715.5	12.2	98	109.3	15
2-Ethyltoluene	128.8	4.1	97	24.9	19
1,2,4-Trimethylbenzene	322.8	4.1	99	61.9	19
1,4-Dichlorobenzene	275.4	124.7	55	87.2	32
1,2-Dichlorobenzene	74.8	24.7	67	30.3	40
1,3-Diethylbenzene	28.8	ND	100	5.0	17
1,4-Diethylbenzene	159.0	2.8	98	25.9	16
TOTAL	3708.6	1258.7	66	2696.6	73

[1] VOC Loadings: Input based on grit chamber and effluent based on aeration effluent
[2] Removal by all mechanisms
[3] Merged with 1,3,5-Trimethylbenzene

Table 4.6 Estimated VOC Loadings and Emissions - Highland Creek WPCP[4]

COMPOUNDS	WASTEWATER VOC LOADINGS (g/d)[1] INPUT	EFFLUENT	OVERALL % REMOVAL[2]	VOC AIR EMISSIONS (g/d)	% VOC STRIPPED
Dichloromethane	1407.5	741.3	47	325.5	23
1,1-Dichloroethane	62.7	168.8	-169	99.4	159
Chloroform	397.8	31.4	92	78.9	20
1,1,1-Trichloroethane	7600.7	153.3	98	1769.8	23
Bromodichloroethane	18.9	ND	100	7.8	41
Trichloroethylene	15985.6	229.0	99	161.9	1
Toluene	1056.4	170.2	84	265.4	25
Dibromochloromethane	9.4	ND	100	ND	NA
Tetrachloroethylene	153.6	17.2	89	60.4	39
Ethylbenzene	194.9	4.7	98	29.0	15
m,p-xylene	829.5	9.3	99	144.1	17
o-xylene	522.2	10.9	98	75.3	14
Cumene	106.2	3.1	97	33.0	31
Propylbenzene	303.2	7.8	97	81.0	27
3&4-Ethyltoluene[3]	2724.6	29.7	99	370.3	14
2-Ethyltoluene	440.3	14.1	97	62.8	14
1,2,4-Trimethylbenzene	1736.4	17.2	99	193.0	11
1,3-Dichlorobenzene	1.6	ND	100	0.3	22
1,4-Dichlorobenzene	355.4	123.6	65	96.4	27
1,2-Dichlorobenzene	91.0	15.6	83	10.4	11
1,3-Diethylbenzene	83.2	ND	100	24.7	30
1,4-Diethylbenzene	310.7	6.2	98	60.3	19
TOTAL	34391.8	1753.4	95	3949.5	11

[1] VOC Loadings: Input based on grit chamber and effluent based on aeration effluent

[2] Removal by all mechanisms

[3] Merged with 1,3,5-Trimethylbenzene

[4] Old plant only

Table 4.7 Estimated VOC Loadings and Emissions - Lakeview WPCP[2]

COMPOUNDS	WASTEWATER VOC LOADINGS (g/d)[1] INPUT	EFFLUENT	OVERALL % REMOVAL[3]	VOC AIR EMISSIONS (g/d)	% VOC STRIPPED
Dichloromethane	4198.1	1368.0	67	2316.1	55
1,1-Dichloroethane	26.8	5.1	81	6.7	25
Chloroform	435.3	79.0	82	85.1	20
1,2-Dichloroethane	83.9	31.3	63	25.9	31
1,1,1-Trichloroethane	866.7	15.0	98	293.6	34
Benzene	31.2	ND	100	4.1	13
1,2-Dichloropropane	2.2	ND	100	ND	NA
Bromodichloroethane	25.8	ND	100	7.7	30
Trichloroethylene	72.1	14.5	80	21.3	29
Toluene	1468.7	17.2	99	361.2	25
Dibromochloromethane	1.8	ND	100	ND	NA
Tetrachloroethylene	358.0	17.2	95	163.0	46
Ethylbenzene	214.6	3.5	98	92.2	43
m,p-xylene	967.4	5.3	99	297.9	31
o-xylene	574.5	8.8	98	109.8	19
Cumene	50.7	ND	100	12.0	24
Propylbenzene	109.4	ND	100	38.1	35
3&4-Ethyltoluene	893.6	2.7	100	200.7	22
1,3,5-Trimethylbenzene	371.6	1.8	100	88.2	24
2-Ethyltoluene	276.1	2.7	99	284.7	103
1,2,4-Trimethylbenzene	874.6	1.8	100	218.3	25
1,3-Dichlorobenzene	2.6	ND	100	0.7	27
1,4-Dichlorobenzene	216.8	49.1	77	69.7	32
1,2-Dichlorobenzene	57.2	10.3	82	14.4	25
1,3-Diethylbenzene	80.0	ND	100	13.9	17
1,4-Diethylbenzene	309.1	4.4	99	52.7	17
TOTAL	12568.7	1638.1	87	4778.1	38

[1] VOC Loadings: Input based on grit chamber and effluent based on aeration effluent

[2] Plant 3 only

[3] Removal by all mechanisms

Table 4.8 Estimated VOC Loadings and Emissions - Waterloo WPCP[2]

COMPOUNDS	WASTEWATER VOC LOADINGS (g/d)[1] INPUT	EFFLUENT	OVERALL % REMOVAL[3]	VOC AIR EMISSIONS (g/d)	% VOC STRIPPED
Dichloromethane	148.1	121.5	18	15.2	10
Chloroform	31.1	22.2	29	3.2	10
1,2-Dichloroethane	5.2	4.0	23	0.4	7
1,1,1-Trichloroethane	0.6	0.6	NA	0.7	108
Trichloroethylene	3.7	3.8	-4	ND	NA
Toluene	5.1	3.2	37	2.1	42
Tetrachloroethylene	15.9	12.7	20	17.3	109
1,2,4-Trimethylbenzene	0.5	ND	100	1.0	187
1,3-Dichlorobenzene	0.6	ND	100	0.0	3
1,4-Dichlorobenzene	38.0	35.2	7	2.4	6
1,2-Dichlorobenzene	5.4	3.1	42	0.1	1
TOTAL	254.1	206.3	19	42.3	17

[1] VOC Loadings: Input based on aeration influent and effluent based on aeration effluent
[2] Old plant only
[3] Removal by all mechanisms

influent samples, which were taken from the basin, are not representative of the actual influent. The mass balance data for Waterloo is therefore inconclusive.

For the three plants excluding Waterloo, the mass balances suggest that a high percentage of most of the measured VOCs were removed in the treatment process. In most cases, the estimated fraction removed by air stripping did not account for the entire observed removal. This suggests that other mechanisms such as biodegradation and sorption are also responsible for a fraction of the overall removal. It is interesting to note that a high overall removal of VOCs was observed at Highland Creek even though the estimated removal by air stripping was relatively low. This suggests that if air stripping is minimized by reducing the aeration rate, a high degree of VOC removal can still be achieved.

The results of the mass balance computations, although based on minimal wastewater sampling, are encouraging and suggest that meaningful mass balances on VOCs can be made at full scale treatment plants. A more comprehensive investigation in this area is needed.

4.5 Modelling of VOC Emissions

It is of interest to compare the predictions of various mathematical models with the measured VOC emission test results. In the first series of comparisons, different models were used to predict the off-gas VOC concentrations at the influent end of the aeration basins. These predictions are then compared with the measured values.

For diffused aeration systems the simplest predictive model assumes that the off-gas exiting the system is in equilibrium with the wastewater, i.e., the off-gas VOC concentrations are at their saturation values. Assuming Henry's law applies, the concentration of a VOC in the off-gas can then be determined from Equation 1,

$$C_G = HC_L \tag{1}$$

Equation 1 was used to predict the VOC concentrations in the off-gas from the influent end of the aeration basins at the four treatment plants. The predictions are based on the average wastewater VOC concentrations for the five day sampling period. These predictions are compared to the average off-gas VOC concentrations measured in the sampling chambers at the same location. Tables 4.9 - 4.12 give the measured and predicted off-gas VOC concentrations and the fractional saturation for each compound for which off-gas and wastewater concentration data and a Henry's law constant were available. It can be seen from these data that the measured off-gas concentrations of most of the compounds are below the predicted saturation concentrations. The fractional saturation in a diffused aeration system is given by (Matter-Muller et al., 1981; Roberts et al., 1984a),

$$f = 1 - \exp(-K_L aV/HQ_G) \tag{64}$$

where

f = fractional saturation,

K_La = stripping rate constant,

V = basin volume,

H = dimensionless Henry's law constant,

Q_G = volumetric air flow rate.

It can be seen from Equation 64 that for a given basin volume and air flow rate, the air bubbles will be close to saturation for high mass transfer rates or low Henry's law constants. For a given system the mass transfer rates for the different compounds are functions of the diffusion coefficients. For the VOCs of concern, there is not great variation among the diffusion coefficients (see Table 2.1). Therefore, for a given system there will not be great variation in the mass transfer rate constants.

From Table 2.1 it can be seen that the Henry's law constants for the tested VOCs vary over more than an order of magnitude. Thus, for a given system, the fractional saturation is largely a function of the Henry's law constant. Review of Tables 4.9 - 4.12 indicates that generally the compounds with low Henry's law constants have higher fractional saturation levels for a given plant. The fact that some compounds exhibit gas phase concentrations greater than the predicted saturation concentrations suggests inaccuracies in the reported Henry's law constants or in the wastewater or off-gas measurements. Since the off-gas measurements were made continuously and the wastewater concentrations were based on daily grab samples, these measurements may not be well correlated. Since the wastewater samples were all taken in the morning they may not be representative of average concentrations, if significant daily concentration variations exist. The Henry's law constants, which are reported for clean water systems, may also be inaccurate because wastewater constituents such as salts, surfactants, or humic acids can result in significant deviations from the pure water values (Yurteri et al., 1987). The results of this analysis suggest that application of the assumption of gas and liquid phase equilibrium in a diffused aeration system will, in many cases, lead to predictions of VOC emissions which are higher than the actual emissions.

The above analysis indicates that the mass transfer rates in the systems tested are slow enough that equilibrium between the gas and liquid phases is not acheived for most compounds. It is, therefore, of interest to investigate the use of some reported mass transfer correlations to predict the stripping rate constants. The correlations proposed by Freeman

Table 4.9 Comparison of Measured Versus Saturated Off-Gas Concentrations in the Aeration Basin (Influent) - Skyway WPCP

Compounds	Off-Gas Concentrations ($\mu g/m^3$) Measured	Off-Gas Concentrations ($\mu g/m^3$) Saturation	Fraction of Saturation
Dichloromethane	1158	1745	0.66
1,1-Dichloroethane	4	32	0.13
Chloroform	212	163	1.30
1,1,1-Trichloroethane	65	41	1.59
Trichloroethylene	50	227	0.22
Toluene	1215	2544	0.48
Tetrachloroethylene	40	286	0.14
Ethylbenzene	48	54	0.89
m,p-xylene	152	183	0.83
o-xylene	79	241	0.33
Cumene	24	218	0.11
Propylbenzene	54	208	0.26
1,4-Dichlorobenzene	73	210	0.35
1,2-Dichlorobenzene	41	60	0.68

Table 4.10 Comparison of Measured Versus Saturated Off-Gas Concentrations in the Aeration Basin (Influent) - Highland Creek WPCP

Compounds	Off-Gas Concentrations ($\mu g/m^3$) Measured	Off-Gas Concentrations ($\mu g/m^3$) Saturation	Fraction of Saturation
Dichloromethane	449	957	0.47
1,1-Dichloroethane	138	621	0.22
Chloroform	113	47	2.44
1,1,1-Trichloroethane	2588	634	4.08
Benzene	2	48	0.04
Trichloroethylene	289	7899	0.04
Toluene	786	2551	0.31
Tetrachloroethylene	82	358	0.23
Ethylbenzene	64	54	1.19
m,p-xylene	241	129	1.87
o-xylene	119	112	1.07
Cumene	53	61	0.87
Propylbenzene	130	77	1.69
1,4-Dichlorobenzene	133	184	0.72
1,2-Dichlorobenzene	14	23	0.64

Table 4.11 Comparison of Measured Versus Saturated Off-Gas Concentrations in the Aeration Basin (Influent) - Lakeview WPCP

Compounds	Off-Gas Concentrations ($\mu g/m^3$) Measured	Saturation	Fraction of Saturation
Dichloromethane	1186	11174	0.11
1,1-Dichloroethane	4	154	0.03
Chloroform	46	296	0.15
1,2-Dichloroethane	11	28	0.40
1,1,1-Trichloroethane	202	389	0.52
Benzene	4	51	0.08
Bromodichloroethane	4	5	0.74
Trichloroethylene	17	174	0.10
Toluene	339	1844	0.18
Tetrachloroethylene	113	1074	0.11
Ethylbenzene	82	246	0.33
m,p-xylene	274	836	0.33
o-xylene	103	464	0.22
Cumene	11	61	0.18
Propylbenzene	34	88	0.39
1,3,5-Trimethylbenzene	75	7455	0.01
1,4-Dichlorobenzene	27	154	0.18
1,2-Dichlorobenzene	8	42	0.20

Table 4.12 Comparison of Measured Versus Saturated Off-Gas Concentrations in the Aeration Basin (Influent) - Waterloo WPCP

Compounds	Off-Gas Concentrations ($\mu g/m^3$) Measured	Saturation	Fraction of Saturation
Dichloromethane	97	705	0.14
Chloroform	21	158	0.13
1,2-Dichloroethane	2	7	0.33
1,1,1-Trichloroethane	4	4	1.03
Toluene	21	44	0.48
Tetrachloroethylene	109	692	0.16
1,4-Dichlorobenzene	14	147	0.10
1,2-Dichlorobenzene	1	15	0.04

(1982) and Roberts et al. (1984a) were examined. Freeman (1982) proposed using correlations developed by Calderbank (1967) to estimate the liquid phase mass transfer coefficient and the interfacial area (Equations 50 and 51). Methods for estimation of the parameters required for application of Equations 50 and 51 are also given by Freeman (1982). The bubble terminal velocity in Equation 51 was estimated using the drag coefficient curve of Haberman and Morton (Perry et al., 1963). For mass transfer between liquids and gas bubbles it has been found that the gas phase mass transfer coefficient can be neglected, except for systems with very high gas flow rates (Calderbank, 1967). The stripping rate constant, K_La, was estimated for each compound and each system using Equations 50 and 51. Similarly, the correlations of Akita and Yoshida (1974) and Yaron and Gal-Or (1971) (Equations 52 and 54) were also used to estimate the liquid phase mass transfer coefficients. The interfacial area in both cases was estimated by Equation 57, using correlations of Akita and Yoshida (1974) to estimate gas holdup fraction and bubble diameter. The bubble diameter for the Highland Creek plant, which uses fine bubble aeration was estimated to be 2 mm (Metcalf and Eddy, Inc., 1979). The calculated bubble diameter for Highland Creek was similar to those calculated for the other plants. Visual observations, however, indicated that the bubbles at Highland Creek were significantly smaller than at the other plants. For all of these estimates, the required physical properties of the wastewater were taken to be those of clean water, since no other values were available.

The estimated stripping rate constants were used to predict the off-gas VOC concentrations in the influent section of each aeration basin from Equation 65,

$$C_G = HC_L[1 - \exp(-K_LaV/HQ_G)] \tag{65}$$

In this case the basin volume was taken as the volume under the sampling chamber and the gas flow rate was taken as the average gas flow rate into the sampling chamber. The wastewater VOC concentration was taken as the

average measured concentration for the one week sampling period. These estimates are given in Tables 4.13 - 4.16 together with the measured average off-gas concentrations and the estimated saturation concentrations. For the Burlington Skyway plant, the concentrations estimated using the film theory are also presented. These estimates were obtained by multiplying the oxygen transfer rate constant by the ratio of the diffusion coefficient of the VOC to that of oxygen. The oxygen transfer rate constant was determined by a field measurement, using the off-gas technique (Redmon et al., 1983), at the same location as the VOC sampling. The oxygen transfer measurement was not carried out at the same time as the VOC sampling, so that it may not be representative of the conditions during VOC sampling. An oxygen K_La value of 4.0 h^{-1} was measured, corresponding to an oxygen transfer efficiency of 2.9%.

Review of Tables 4.13 - 4.16 indicates that, for the compounds which exhibit partial saturation, all of the correlations generally predict concentrations higher than the measured values. The correlations of Calderbank (1967) and Akita and Yoshida (1974) appear to predict that the gas bubbles will be saturated or nearly so in all cases. In some cases the correlation of Yaron and Gal-Or (1971) provides slightly better predictions, but still generally higher than the measured values. The film theory appears to predict lower concentrations than the other correlations. For the compounds exhibiting low fractional saturation, the film theory gives somewhat better predictions, although still generally higher than the measured values. For some compounds measured at or near saturation, the film theory predicts concentrations lower than the measured values. It should be noted that higher VOC concentration predictions would result from application of the penetration or surface renewal theories. These theories predict that the mass transfer coefficient will be proportional to the square root of the diffusion coefficient. In general, predictions from these theories would be worse than for the film theory, in the cases studied. Prediction of VOC stripping rates from the measured oxygen transfer rate requires further study in full scale plants before this technique can be applied in practice.

Table 4.13 Comparison of Measured Versus Predicted Off-gas Concentrations in the Aeration Basin (Influent) - Skyway WPCP

	Off-Gas Concentrations ($\mu g/m^3$)					
Compounds	Measured	Saturation	Calderbank	Akita & Yoshida	Yaron & Gal-Or	Film Theory
Dichloromethane	1158	1745	1745	1745	1744	1587
1,1-Dichloroethane	4	32	32	32	31	22
Chloroform	212	163	163	163	163	140
1,1,1-Trichloroethane	65	41	41	41	40	28
Trichloroethylene	50	227	227	227	204	109
Toluene	1215	2544	2544	2544	2456	1560
Tetrachloroethylene	40	286	281	255	140	49
Ethylbenzene	48	54	54	54	51	29
m,p-xylene	152	183	183	183	178	114
o-xylene	79	241	241	241	234	150
Cumene	24	218	218	215	153	60
Propylbenzene	54	208	208	208	194	105
1,4-Dichlorobenzene	73	210	210	210	210	179
1,2-Dichlorobenzene	41	60	60	60	60	56

Table 4.14 Comparison of Measured Versus Predicted Off-gas Concentrations in the Aeration Basin (Influent) - Highland Creek WPCP

	Off-Gas Concentrations ($\mu g/m^3$)				
Compounds	Measured	Saturation	Calderbank	Akita & Yoshida	Yaron & Gal-Or
Dichloromethane	449	957	957	957	957
1,1-Dichloroethane	138	621	621	621	621
Chloroform	113	47	47	47	47
1,1,1-Trichloroethane	2588	634	634	634	634
Benzene	2	48	48	48	48
Trichloroethylene	289	7899	7899	7899	7899
Toluene	786	2551	2551	2551	2551
Tetrachloroethylene	82	358	355	351	303
Ethylbenzene	64	54	54	54	54
m,p-xylene	241	129	129	129	129
o-xylene	119	112	112	112	112
Cumene	53	61	61	61	59
Propylbenzene	130	77	77	77	77
1,4-Dichlorobenzene	133	184	184	184	184
1,2-Dichlorobenzene	14	23	23	23	23

Table 4.15 Comparison of Measured Versus Predicted Off-gas Concentrations in the Aeration Basin (Influent) - Lakeview WPCP

Compounds	Off-Gas Concentrations ($\mu g/m^3$)				
	Measured	Saturation	Calderbank	Akita & Yoshida	Yaron & Gal-Or
Dichloromethane	1186	11174	11174	11174	11169
1,1-Dichloroethane	4	154	154	154	151
Chloroform	46	296	296	296	296
1,2-Dichloroethane	11	28	28	28	28
1,1,1-Trichloroethane	202	389	389	389	382
Benzene	4	51	51	51	50
Bromodichloroethane	4	5	5	5	5
Trichloroethylene	17	174	174	174	156
Toluene	339	1844	1844	1844	1782
Tetrachloroethylene	113	1074	1064	980	529
Ethylbenzene	82	246	246	246	233
m,p-xylene	274	836	836	836	813
o-xylene	103	464	464	464	451
Cumene	11	61	61	60	43
Propylbenzene	34	88	88	88	82
1,3,5-Trimethylbenzene	75	7455	4259	2665	845
1,4-Dichlorobenzene	27	154	154	154	154
1,2-Dichlorobenzene	8	42	42	42	42

Table 4.16 Comparison of Measured Versus Predicted Off-gas Concentrations in the Aeration Basin (Influent) - Waterloo WPCP

Compounds	Off-Gas Concentrations ($\mu g/m^3$)				
	Measured	Saturation	Calderbank	Akita & Yoshida	Yaron & Gal-Or
Dichloromethane	97	705	705	705	705
Chloroform	21	158	158	158	158
1,2-Dichloroethane	2	7	7	7	7
1,1,1-Trichloroethane	4	4	4	4	4
Trichloroethylene	NA	53	53	53	50
Toluene	21	44	44	44	44
Tetrachloroethylene	109	692	691	661	388
1,3-Dichlorobenzene	NA	2	2	2	2
1,4-Dichlorobenzene	14	147	147	147	147
1,2-Dichlorobenzene	1	15	15	15	15

From the above analysis it can be seen that the assumption of equilibrium between the liquid and gas phases can be used to make conservatively high estimates of VOC emissions if valid Henry's law constants are available. These estimates require a minimum of data and simple calculations. There seems to be no advantage in using the more complex correlations, which tend to give the same prediction. It may be of value, however, to investigate modifications of these correlations, specifically for wastewater systems. It should be noted that the physical properties of the wastewater, such as viscosity and surface tension, used in the analysis were those of clean water rather than wastewater. It is likely that this approximation affects the accuracy of the correlations. In addition, the available Henry's law constants and diffusion coefficients are generally for clean water systems. Henry's law constants for VOCs have been observed to change with the addition of contaminants to the water (Yurteri et al., 1987). Also, more extensive wastewater sampling is needed to account for variability in wastewater VOC concentrations.

The estimation of the stripping rate constant requires the estimation of the specific interfacial area as well as the mass transfer coefficient. The interfacial area is a function of bubble size and the gas holdup fraction. The correlations used to estimate bubble diameter do not take into account the method of introducing the gas bubbles or the initial bubble size. Visual observations and oxygen transfer efficiency measurements of coarse and fine bubble air diffusers suggest that initial bubble size is important in determining the ultimate bubble size. The correlations used to estimate bubble size apparently assume that, at a particular level of mixing intensity, an equilibrium between bubble break-up and coalescence will determine the bubble size. Since the correlations were developed in controlled laboratory bubble columns, they may not be applicable to large scale wastewater treatment aeration vessels. If the actual bubbles are larger than the estimated size, the actual interfacial areas would be lower than predicted. Therefore, the actual stripping rate constants would be lower than predicted, and this could account for the overprediction of the fractional saturation by the

models. Table 4.17 gives the bubble diameters and specific interfacial areas estimated using the correlations of Calderbank (1967) and Akita and Yoshida (1974). It can be seen that the estimates are in reasonable agreement. It should be noted that the column diameter used in the Akita and Yoshida correlations was taken as the maximum value of 0.6 m as recommended by the authors.

Table 4.17 Comparison of Bubble Diameter and Interfacial Area Estimates

Plant	Bubble Diameter (mm)		Specific Interfacial Area (m^2/m^3)	
	Calderbank	Akita and Yoshida	Calderbank	Akita and Yoshida
Skyway	7.2	4.6	30.8	31.3
Highland Creek	6.1	6.0	4.5	3.6
Lakeview	6.3	5.8	5.9	4.9
Waterloo	5.7	6.7	1.9	1.3

It is of interest to compare the oxygen transfer rate constants, predicted using the mass transfer correlations, with the measured value. The comparison is shown in Table 4.18 for the Skyway plant. All three correlations predict a higher rate constant than the measured value. The estimate using the correlation of Yaron and Gal-Or (1971) is closest to the measured value. Calderbank's correlation yields an estimate an order of magnitude above the measured value. Perhaps with a refined estimate of the interfacial area and application of a dirty water/clean water adjustment factor, the correlation of Yaron and Gal-Or could be applied to predict oxygen transfer rates in large scale wastewater treatment systems. Since the VOC stripping rates do not appear to be correlated in a simple way with the oxygen transfer rate, further refinements may be needed for application to VOC stripping.

Table 4.18 Comparison of Oxygen Transfer Rate Predictions for Burlington Skyway Plant Aeration Basin

K_La (hr^{-1}) Predicted			Measured
Calderbank	Akita and Yoshida	Yaron and Gal-Or	
48.8	27.8	10.8	4.0

In general, it appears that the models proposed for estimating VOC stripping rates do not provide accurate predictions of the actual rates. In most cases the stripping rates are overestimated by the models. Compounds with low Henry's law constants are more closely predicted than those with higher Henry's law constants. The correlation of Yaron and Gal-Or (1971) provides a slightly better estimate of off-gas concentrations than the other correlations examined. Film theory, using measured oxygen transfer rates, may provide even better estimates of VOC emissions, but the technique needs to be refined. It appears that additional research and development effort will be required to refine existing models or develop new models which are applicable to full scale treatment plants.

Table 4.18 Comparison of Oxygen Transfer Rate Predictions for [illegible] Skyway Plant Aeration Basin

[illegible]

In general, it appears that the model [illegible] stripping rates is not [illegible] in most cases [illegible] Compounds with [illegible] those with [illegible] (1979) [illegible] than the other [illegible] transfer rates and [illegible] compounds [illegible] development [illegible] parameters which [illegible]

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions can be drawn from the present work:

1. The results of the off-gas sampling and analysis at four Ontario municipal wastewater treatment plants have demonstrated that many volatile organic compounds on the MISA list of pollutants are emitted to the atmosphere from aerated grit chambers and activated sludge aeration basins.

- The compounds observed in highest concentration in the off-gases at the four plants tested were:
  - dichloromethane
  - toluene
  - 1,1,1-trichloroethane
  - m,p-xylene
  - 1,3,5-trimethylbenzene
  - 3-ethyltoluene
  - 4-ethyltoluene

- The total VOC emission rates for the measured compounds ranged from approximately 1.5 to 75 g/10^3 m^3 of wastewater treated.

- The maximum total off-gas VOC concentrations for the measured compounds ranged from approximately 300 to 6500 $\mu g/m^3$.

2. The fraction of the VOCs entering a treatment plant which are removed by stripping increases with increasing aeration rate. Thus VOC stripping can be minimized by minimizing the aeration rate.

3. A high percentage of the VOCs entering a treatment plant are removed in the treatment process even when air stripping is minimized.

4. The off-gas sampling and analytical techniques and equipment used in the present study appeared to provide a satisfactory method for measuring VOC emissions from diffused aeration systems at wastewater treatment plants. However, more extensive off-gas and wastewater testing will be required to fully characterize the behaviour of VOCs in wastewater treatment plants and to develop useful predictive models.

5. In almost all cases, the mass transfer models tested predicted off-gas concentrations higher than the measured values. The predictions based on the film theory, combined with the measured oxygen transfer rate constant, generally gave better predictions than the semi-empirical mass transfer models. Conservatively high estimates of VOC concentrations in the off-gas from diffused aeration processes may be obtained by assuming equilibrium between the gas and liquid phases and that Henry's law applies.

5.2 Recommendations

The following recommendations are made as a result of the present work:

1. A pilot plant study, as proposed for the second phase of the present study, should be carried out. The pilot plant investigation should further test existing mass transfer models for prediction of VOC stripping rates and, if possible, develop new or modified models to give more accurate predictions. In addition, the pilot plant study should test the effects of plant design and operational variables on VOC stripping. The pilot plant study will enable the testing to be done under more controllable conditions than can be attained in a full scale plant.

2. A more comprehensive study of VOC stripping should be carried out at several full scale treatment plants in conjunction with the pilot plant study. More frequent wastewater sampling should be performed simultaneously with the off-gas sampling. Oxygen transfer rate measurements should also be carried at the time of the VOC sampling. This

work is needed to validate the findings of the pilot plant study in terms of full scale plant performance.

3. A laboratory study should be carried out to investigate the differences between clean water and dirty water VOC stripping rates and Henry's law constants with the aim of developing meaningful correction factors for field conditions.

4. A comprehensive study should be carried out at several municipal wastewater treatment plants to test the available computer based models for predicting the fate of volatile organic compounds.

5. Until better models are developed, application of Henry's law with the gas-liquid equilibrium model should be used to predict off-gas emissions from diffused aeration processes, with the understanding that the predictions will be conservatively high.

ACKNOWLEDGEMENTS

The cooperation and assistance of several individuals and organizations was necessary in carrying out this study. The authors wish to thank Tony Ho and Hugh Monteith of the Ontario Ministry of the Environment for their guidance and helpful comments throughout the project.

The work of Wayne Bedford (Environment Canada, Wastewater Technology Centre) on the design and construction of the off-gas sampling system and field sampling program is greatly appreciated. Thanks are due to Brian MacGillivray (Environment Canada, Wastewater Technology Centre) and Tom Dann, Jim Mar, and Daniel Wang (Environment Canada, River Road Environmental Technology Centre) for off-gas analysis and data processing. Thanks are also due to Mike Hribljan for conducting oxygen transfer tests, to Jim Matthews (Environment Canada, Wastewater Technology Centre) for assistance with field sampling, and to Christie Davey-Zarifis (Environment Canada, Wastewater Technology Centre) for manuscript preparation. The cooperation and assistance of the staffs of the Burlington Skyway, Toronto Highland Creek, Mississauga Lakeview, and Waterloo water pollution control plants are appreciated.

The study was funded by the Ontario Ministry of the Environment and Environment Canada.

ACKNOWLEDGEMENTS

The cooperation and assistance of [illegible] and [illegible] organizations [illegible] in carrying out this study. [illegible] to thank [illegible] Department of the [illegible] Environment for their guidance and helpful comments throughout the [illegible].

The work of [illegible] Control in the [illegible] field sampling program [illegible] appreciated. [illegible] Dunn, [illegible] Environmental [illegible] Environmental [illegible] Ontario [illegible] and [illegible] Canada, [illegible] cooperation and assistance [illegible] Highland [illegible] plants [illegible] appreciated.

The study was funded by [illegible] Environment Canada.

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NOMENCLATURE

A	Interfacial Area (m^2)
a	Specific Interfacial Area (m^2/m^3)
a	Adjustable Parameter
a	Ratio of solute concentrations (interface/bulk phase)
b	Evaporation Coefficient
b	Adjustable Parameter
C	Concentration (mg/L)
C	Solubility (mg/L)
C	Adjustable Parameters
D	Diffusion Coefficient
d	Diameter (m)
E	Evaporation Rate of Water (g/d)
E	Aerator Power Delivery Efficiency (fraction)
e	Gas Holdup Ratio
F	Fractional Removal
f	Correction Factor (wastewater/pure water O_2 transfer)
f	Fractional Saturation
Fr	Froude Number (dimensionless)
G	Mass of Water (g)
g	Gravitational Constant (980.62 cm/s^2)
H	Henry's Law Constant (dimensionless)
h	Depth (m, cm)
K	Overall Mass Transfer Coefficient (m/s)
K	Sorption Partition Coefficient
k	Mass Transfer Coefficient (m/s)
M	Mixed Liquor Suspended Solids Concentration (mg/L)
M	Molecular Weight
m	Mass (mg)
N	Mixer Speed (rpm)
N	Oxygen Transfer Rating of Surface Aerator (lb O_2/h.hp)
P	Vapour Pressure (mm Hg)
P	Horsepower (hp)
Pe	Peclet Number (dimensionless)
Po	Power Number (dimensionless)
Q	Volumetric Flowrate (m^3/d)
q	Sorption Concentration (mg/L)
R	Gas Constant
R	$d(k_v)/d(Q_G)$
r	Removal Rate
Re	Reynold's Number (dimensionless)
S	Slope
Sc	Schmidt Number (dimensionless)
Sh	Sherwood Number (dimensionless)
st	Surface Tension (kg/s^2)
T	Temperature (°K,°C)
t	Time (s)

U	Velocity (m/s)
U	Wind Speed (m/h)
V	Volume of Reactor (m^3)
V	Molecular Volume (cm^3)
v	velocity (m/s, cm/s)
W	Volatilization Flux (g/min.m^2)
W	Independent Variable
X	Pool Diameter (m)
X	Independent Variable
Y	Depth of Water (m)
Y	Independent Variable
Z	Height (cm)
Z	Depth (m)
β	Ratio of Mass Transfer Coefficients
μ	Kinematic Viscosity (g/cm.s)
π	Pi (3.14159)
ρ	Density (kg/m^3)
ψ	Ratio of Mass Transfer Coefficients

Subscripts

b	Biodegradation
c	Current
c	Column
e	Effluent
fld	Field
G	Gas Phase
L	Liquid Phase
lab	Laboratory
org	Organic
oxy	Oxygen
p	Bubble
p	Partition
rel	Relative
s	Sludge
s	Solute
s	Sorption
s	Stokes
t	Terminal
t	Total
v	Volatilization
w	Water
w	Wind
wat	Water
*	Shear
10	Height (10 cm)
8	Height (8 m)

Superscripts

b	Adjustable Parameter
c	Adjustable Parameter
d	Adjustable Parameter
m	Adjustable Parameter
n	Number of Reactors
n	Exponent
o	Initial
org	Organic
ref	Reference
w	Exponent
x	Exponent
y	Exponent
z	Exponent
*	Equilibrium
*	Shear

APPENDICES

N.B. The designation "NA" in all tables in the appendices means "not detected" for analytical data and "not applicable" for calculated values.

APPENDIX A

Off-Gas Concentration Data

TABLE A1: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY GRIT CHAMBER

Compounds	Concentration (ug/m**3) DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	2	1	1	1
Dichloromethane	1087	1336	979	879	1070
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	5	5	4	2	4
Chloroform	123	366	304	132	231
1,2-Dichloroethane	NA	2	1	NA	1
1,1,1-Trichloroethane	191	194	88	70	136
Benzene	36	58	43	39	44
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	21	19	23	19	20
Trichloroethylene	213	110	82	77	120
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	447	1940	332	312	757
Dibromochloromethane	4	4	7	5	5
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	86	68	88	81	81
Ethylbenzene	72	295	43	51	115
m,p-xylene	300	953	173	183	402
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	1	1	3	3	2
o-xylene	150	460	125	128	216
Cumene	41	96	43	77	64
Propylbenzene	129	205	103	179	154
4-Ethyltoluene	330	495	247	389	365
3-Ethyltoluene	168	206	123	172	167
1,3,5-Trimethylbenzene	207	271	160	189	207
2-Ethyltoluene	125	172	91	106	124
1,2,4-Trimethylbenzene	499	399	265	281	361
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	92	48	53	45	59
1,2-Dichlorobenzene	19	15	86	94	53
1,3-Diethylbenzene	30	16	13	15	18
1,4-Diethylbenzene	185	166	95	106	138
1,2-Diethylbenzene	20	37	14	19	23

TABLE A2: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY AERATION BASIN (INFLUENT)

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	1074	1350	1111	1099	1158
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	5	5	4	3	4
Chloroform	116	306	277	149	212
1,2-Dichloroethane	NA	2	2	NA	1
1,1,1-Trichloroethane	110	72	41	38	65
Benzene	6	7	6	11	8
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	13	20	17	14	16
Trichloroethylene	82	48	32	38	50
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	1588	1146	902	1225	1215
Dibromochloromethane	3	5	4	4	4
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	49	41	32	38	40
Ethylbenzene	28	117	24	22	48
m,p-xylene	90	356	87	75	152
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	49	154	61	51	79
Cumene	13	16	41	26	24
Propylbenzene	37	38	84	57	54
4-Ethyltoluene	71	68	134	89	91
3-Ethyltoluene	39	36	71	53	50
1,3,5-Trimethylbenzene	52	45	69	48	54
2-Ethyltoluene	37	34	54	40	41
1,2,4-Trimethylbenzene	116	95	126	91	107
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	77	83	71	61	73
1,2-Dichlorobenzene	12	12	52	87	41
1,3-Diethylbenzene	5	5	8	6	6
1,4-Diethylbenzene	37	40	45	32	38
1,2-Diethylbenzene	5	4	6	6	5

TABLE A3: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY AERATION BASIN (MIDPOINT)

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	1055	919	675	744	848
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	5	3	2	2	3
Chloroform	108	198	168	95	142
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	86	39	24	21	42
Benzene	1	1	1	2	1
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	14	11	10	9	11
Trichloroethylene	52	14	12	17	24
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	44	20	24	102	47
Dibromochloromethane	3	3	3	2	3
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	50	34	24	27	34
Ethylbenzene	10	39	9	9	17
m,p-xylene	23	99	25	25	43
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	14	39	16	16	21
Cumene	5	4	20	12	10
Propylbenzene	18	14	45	32	27
4-Ethyltoluene	22	16	46	34	29
3-Ethyltoluene	13	9	26	18	17
1,3,5-Trimethylbenzene	18	11	28	19	19
2-Ethyltoluene	15	10	25	19	17
1,2,4-Trimethylbenzene	41	24	44	36	36
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	77	60	50	46	58
1,2-Dichlorobenzene	9	8	28	57	25
1,3-Diethylbenzene	8	1	3	2	4
1,4-Diethylbenzene	18	15	22	17	18
1,2-Diethylbenzene	2	1	4	3	3

TABLE A4: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY AERATION BASIN (EFFLUENT)

Compounds	Concentration (ug/m**3)		
	DAY 1	DAY 2	AVERAGE
1,1-Dichloroethylene	NA	NA	NA
Dichloromethane	1077	998	1038
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	4	3	3
Chloroform	111	206	158
1,2-Dichloroethane	NA	NA	NA
1,1,1-Trichloroethane	75	32	53
Benzene	NA	1	0
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	14	13	13
Trichloroethylene	29	9	19
1,1,2-Trichloroethane	NA	NA	NA
Toluene	NA	NA	NA
Dibromochloromethane	4	4	4
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	50	35	43
Ethylbenzene	NA	8	4
m,p-xylene	6	10	8
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA
o-xylene	3	4	3
Cumene	3	3	3
Propylbenzene	6	5	6
4-Ethyltoluene	4	3	4
3-Ethyltoluene	2	1	2
1,3,5-Trimethylbenzene	3	2	2
2-Ethyltoluene	3	2	2
1,2,4-Trimethylbenzene	8	9	8
1,3-Dichlorobenzene	NA	NA	NA
1,4-Dichlorobenzene	91	72	82
1,2-Dichlorobenzene	9	6	8
1,3-Diethylbenzene	5	NA	2
1,4-Diethylbenzene	8	6	7
1,2-Diethylbenzene	NA	NA	NA

TABLE A5: OFF-GAS CONCENTRATIONS - HIGHLAND CREEK GRIT CHAMBER

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	7	23	61	74	41
Dichloromethane	1004	122	745	1499	843
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	19	3	7	45	18
Chloroform	86	4	3	188	70
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	2256	245	430	2815	1436
Benzene	3	NA	NA	NA	1
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	1	1	1	NA	1
Bromodichloroethane	21	3	NA	10	8
Trichloroethylene	69	38	NA	745	213
1,1,2-Trichloroethane	13	NA	34	7	13
Toluene	612	34	NA	82	182
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	58	NA	NA	NA	14
Ethylbenzene	62	21	NA	24	27
m,p-xylene	272	53	7	65	99
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	17	NA	NA	1	4
o-xylene	171	19	7	58	64
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	57	14
4-Ethyltoluene	4	826	600	838	567
3-Ethyltoluene	2433	230	175	117	739
1,3,5-Trimethylbenzene	1090	447	357	613	627
2-Ethyltoluene	493	245	140	251	282
1,2,4-Trimethylbenzene	NA	138	409	443	248
1,3-Dichlorobenzene	4	179	100	129	103
1,4-Dichlorobenzene	222	NA	15	29	67
1,2-Dichlorobenzene	NA	27	6	12	11
1,3-Diethylbenzene	NA	NA	NA	368	92
1,4-Diethylbenzene	88	607	327	625	412
1,2-Diethylbenzene	739	NA	NA	NA	185

TABLE A6: OFF-GAS CONCENTRATIONS - HIGHLAND CREEK AERATION BASIN (INFLUENT)

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	9	18	12	10
Dichloromethane	415	NA	733	646	449
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	50	78	248	175	138
Chloroform	115	131	94	113	113
1,2-Dichloroethane	NA	2	1	2	1
1,1,1-Trichloroethane	1593	3123	3235	2402	2588
Benzene	0	4	0	2	2
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	2	NA	1
Bromodichloroethane	17	16	6	10	12
Trichloroethylene	46	646	63	401	289
1,1,2-Trichloroethane	11	25	7	14	14
Toluene	612	1516	677	341	786
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	86	97	103	40	82
Ethylbenzene	34	93	55	74	64
m,p-xylene	82	472	199	208	241
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	5	15	16	12	12
o-xylene	48	195	151	83	119
Cumene	29	78	65	40	53
Propylbenzene	82	182	159	97	130
4-Ethyltoluene	129	5	423	179	184
3-Ethyltoluene	84	186	187	78	134
1,3,5-Trimethylbenzene	84	230	281	165	190
2-Ethyltoluene	44	123	124	76	92
1,2,4-Trimethylbenzene	156	382	462	255	314
1,3-Dichlorobenzene	2	NA	NA	NA	1
1,4-Dichlorobenzene	132	138	145	116	133
1,2-Dichlorobenzene	20	21	9	8	14
1,3-Diethylbenzene	12	30	26	42	27
1,4-Diethylbenzene	46	106	129	75	89
1,2-Diethylbenzene	8	18	22	12	15

TABLE A7: OFF-GAS CONCENTRATIONS - HIGHLAND CREEK AERATION BASIN (MIDPOINT)

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	10	41	14	16
Dichloromethane	436	628	850	659	643
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	54	85	298	175	153
Chloroform	123	69	105	114	103
1,2-Dichloroethane	NA	1	1	2	1
1,1,1-Trichloroethane	1640	2295	3228	2314	2369
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	1	1	NA	0
Bromodichloroethane	15	10	5	6	9
Trichloroethylene	38	370	57	209	168
1,1,2-Trichloroethane	35	48	4	19	27
Toluene	86	527	292	103	252
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	99	85	50	39	68
Ethylbenzene	24	83	NA	NA	27
m,p-xylene	39	348	134	151	168
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	26	28	23	34	28
o-xylene	28	186	118	70	101
Cumene	20	74	14	39	37
Propylbenzene	61	170	62	91	96
4-Ethyltoluene	56	381	378	209	256
3-Ethyltoluene	47	186	165	98	124
1,3,5-Trimethylbenzene	45	241	275	155	179
2-Ethyltoluene	27	134	125	74	90
1,2,4-Trimethylbenzene	68	363	409	216	264
1,3-Dichlorobenzene	2	NA	NA	NA	1
1,4-Dichlorobenzene	134	147	142	114	134
1,2-Dichlorobenzene	20	23	10	8	15
1,3-Diethylbenzene	9	30	27	18	21
1,4-Diethylbenzene	33	115	133	70	88
1,2-Diethylbenzene	8	21	25	12	16

TABLE A8: OFF-GAS ANALYSIS - HIGHLAND CREEK AERATION BASIN (EFFLUENT)

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	18	38	16	18
Dichloromethane	NA	NA	659	672	333
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	45	115	235	181	144
Chloroform	127	173	96	121	129
1,2-Dichloroethane	NA	3	1	2	2
1,1,1-Trichloroethane	1573	3787	3455	2340	2789
Benzene	2	3	0	2	2
Tetrachloromethane	NA	NA	3	NA	1
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	16	16	11	6	13
Trichloroethylene	33	706	68	199	252
1,1,2-Trichloroethane	10	38	15	20	21
Toluene	NA	273	201	18	123
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	102	132	139	85	115
Ethylbenzene	13	NA	69	62	36
m,p-xylene	7	493	227	162	222
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	4	14	20	16	13
o-xylene	12	190	162	73	109
Cumene	10	88	78	43	55
Propylbenzene	39	203	176	97	129
4-Ethyltoluene	13	398	430	157	250
3-Ethyltoluene	17	206	186	85	124
1,3,5-Trimethylbenzene	14	245	296	167	180
2-Ethyltoluene	14	138	140	80	93
1,2,4-Trimethylbenzene	16	357	471	223	267
1,3-Dichlorobenzene	2	NA	NA	NA	0
1,4-Dichlorobenzene	151	168	172	130	155
1,2-Dichlorobenzene	20	24	11	9	16
1,3-Diethylbenzene	5	36	179	20	60
1,4-Diethylbenzene	19	118	141	69	87
1,2-Diethylbenzene	5	21	26	13	16

TABLE A9: OFF-GAS CONCENTRATIONS - LAKEVIEW GRIT CHAMBER

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	553	606	246	1001	601
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	17	14	NA	22	13
1,2-Dichloroethane	3	11	5	7	6
1,1,1-Trichloroethane	39	24	NA	125	47
Benzene	2	NA	NA	4	2
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	2	NA	2	1
Trichloroethylene	NA	1	NA	10	3
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	97	152	NA	197	112
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	10	34	NA	63	27
Ethylbenzene	18	21	4	90	33
m,p-xylene	67	78	165	321	158
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	28	32	NA	115	44
Cumene	3	3	6	5	4
Propylbenzene	11	10	11	24	14
4-Ethyltoluene	46	39	NA	95	45
3-Ethyltoluene	20	17	21	51	27
1,3,5-Trimethylbenzene	29	29	71	61	47
2-Ethyltoluene	23	19	42	42	31
1,2,4-Trimethylbenzene	103	92	240	166	150
1,3-Dichlorobenzene	11	NA	20	NA	8
1,4-Dichlorobenzene	NA	9	NA	18	7
1,2-Dichlorobenzene	2	2	15	8	7
1,3-Diethylbenzene	6	7	NA	6	5
1,4-Diethylbenzene	26	29	47	37	35
1,2-Diethylbenzene	4	4	9	12	7

TABLE A10: OFF-GAS CONCENTRATIONS - LAKEVIEW AERATION BASIN (INFLUENT)

Compounds	Concentration (ug/m**3) DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	495	1045	1800	1405	1186
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	3	4	4	5	4
Chloroform	40	40	50	54	46
1,2-Dichloroethane	3	15	8	19	11
1,1,1-Trichloroethane	167	128	140	371	202
Benzene	5	1	4	6	4
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	3	4	4	5	4
Trichloroethylene	7	12	16	31	17
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	235	453	278	390	339
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	37	143	132	141	113
Ethylbenzene	27	61	90	150	82
m,p-xylene	106	218	298	474	274
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	48	78	108	179	103
Cumene	3	6	18	17	11
Propylbenzene	18	25	45	47	34
4-Ethyltoluene	67	83	139	156	111
3-Ethyltoluene	35	49	80	83	62
1,3,5-Trimethylbenzene	45	59	99	96	75
2-Ethyltoluene	936	36	57	61	272
1,2,4-Trimethylbenzene	134	169	243	210	189
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	20	32	31	27	27
1,2-Dichlorobenzene	3	2	13	16	8
1,3-Diethylbenzene	7	10	14	12	11
1,4-Diethylbenzene	30	46	59	35	42
1,2-Diethylbenzene	5	7	11	8	8

TABLE A11: OFF-GAS CONCENTRATIONS - LAKEVIEW AERATION BASIN (MIDPOINT)

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	344	913	1008	685	738
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	3	3	2	2	3
Chloroform	33	30	24	24	28
1,2-Dichloroethane	3	11	7	13	8
1,1,1-Trichloroethane	135	59	29	86	77
Benzene	1	NA	NA	NA	0
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	2	3	2	3	2
Trichloroethylene	4	6	3	6	5
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	76	14	6	8	26
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	NA	71	42	42	39
Ethylbenzene	21	10	5	5	10
m,p-xylene	72	12	5	13	26
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	9	9	3	7	7
Cumene	3	2	NA	NA	1
Propylbenzene	7	5	2	2	4
4-Ethyltoluene	56	8	5	4	18
3-Ethyltoluene	30	3	2	2	9
1,3,5-Trimethylbenzene	43	6	3	1	13
2-Ethyltoluene	31	8	5	4	12
1,2,4-Trimethylbenzene	101	11	8	6	31
1,3-Dichlorobenzene	NA	NA	NA	3	1
1,4-Dichlorobenzene	18	35	24	20	24
1,2-Dichlorobenzene	3	3	6	9	5
1,3-Diethylbenzene	8	2	NA	NA	2
1,4-Diethylbenzene	28	7	2	NA	9
1,2-Diethylbenzene	4	2	NA	NA	1

TABLE A12: OFF-GAS CONCENTRATIONS - LAKEVIEW AERATION BASIN (EFFLUENT)

Compounds	Concentration (ug/m**3)			
	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	407	565	270	414
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA
Chloroform	13	14	10	12
1,2-Dichloroethane	6	6	7	6
1,1,1-Trichloroethane	15	10	27	17
Benzene	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	2	2	1	1
Trichloroethylene	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	16	11	11	13
Ethylbenzene	NA	NA	4	1
m,p-xylene	NA	NA	3	1
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
o-xylene	NA	NA	2	1
Cumene	NA	NA	NA	NA
Propylbenzene	2	NA	NA	1
4-Ethyltoluene	3	2	NA	2
3-Ethyltoluene	1	NA	NA	0
1,3,5-Trimethylbenzene	3	NA	NA	1
2-Ethyltoluene	6	NA	3	3
1,2,4-Trimethylbenzene	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA
1,4-Dichlorobenzene	25	18	13	19
1,2-Dichlorobenzene	NA	NA	3	1
1,3-Diethylbenzene	2	NA	NA	1
1,4-Diethylbenzene	5	NA	NA	2
1,2-Diethylbenzene	NA	NA	NA	NA

TABLE A13: OFF-GAS CONCENTRATIONS - WATERLOO AERATION BASIN (INFLUENT)

Compounds	Concentration (ug/m**3) DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	176	126	67	18	97
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	25	19	22	15	21
1,2-Dichloroethane	NA	NA	NA	10	2
1,1,1-Trichloroethane	9	3	3	2	4
Benzene	NA	NA	2	2	1
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	25	21	23	15	21
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	5	364	50	19	109
Ethylbenzene	2	NA	NA	NA	1
m,p-xylene	4	NA	NA	NA	1
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	1	NA	2	NA	1
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	2	NA	1
4-Ethyltoluene	4	NA	8	1	3
3-Ethyltoluene	2	NA	NA	NA	1
1,3,5-Trimethylbenzene	2	2	5	NA	2
2-Ethyltoluene	9	7	2	NA	4
1,2,4-Trimethylbenzene	13	4	18	6	10
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	14	12	17	15	14
1,2-Dichlorobenzene	2	NA	NA	NA	1
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	3	NA	5	NA	2
1,2-Diethylbenzene	NA	NA	NA	NA	NA

TABLE A14: OFF-GAS CONCENTRATIONS - WATERLOO AERATION BASIN (MIDPOINT)

Compounds	Concentration (ug/m**3) DAY 1	DAY 2	DAY 3	Day 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	168	67	67	15	79
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	23	9	22	12	17
1,2-Dichloroethane	NA	NA	NA	8	2
1,1,1-Trichloroethane	9	NA	NA	2	3
Benzene	NA	NA	NA	2	0
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	14	4	19	9	11
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	7	276	56	18	89
Ethylbenzene	2	NA	1	NA	1
m,p-xylene	3	NA	3	NA	1
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA
Propylbenzene	1	NA	NA	NA	0
4-Ethyltoluene	NA	NA	5	NA	1
3-Ethyltoluene	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	2	NA	2	NA	1
2-Ethyltoluene	7	NA	1	NA	2
1,2,4-Trimethylbenzene	5	1	9	4	5
1,3-Dichlorobenzene	NA	NA	1	NA	0
1,4-Dichlorobenzene	16	8	17	14	14
1,2-Dichlorobenzene	2	NA	NA	NA	1
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	2	NA	0
1,2-Diethylbenzene	NA	NA	NA	NA	NA

TABLE A15: OFF-GAS CONCENTRATIONS - WATERLOO AERATION BASIN (EFFLUENT)

Compounds	Concentration (ug/m**3)				
	DAY 1	DAY 2	DAY 3	DAY 4	AVERAGE
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	234	122	72	17	111
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	37	16	25	13	23
1,2-Dichloroethane	NA	1	NA	9	2
1,1,1-Trichloroethane	16	3	2	3	6
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	4	8	9	8	7
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	19	408	61	20	127
Ethylbenzene	1	NA	NA	NA	0
m,p-xylene	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA
Propylbenzene	1	NA	NA	NA	0
4-Ethyltoluene	NA	NA	NA	3	1
3-Ethyltoluene	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	1	NA	1	NA	1
2-Ethyltoluene	7	3	NA	NA	2
1,2,4-Trimethylbenzene	3	1	7	4	4
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	22	14	17	15	17
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA	NA	NA

TABLE A16: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY, DAY 1

Compounds	Concentration (ug/m**3)			
	Grit	Aeration Basin		
	Chamber	Influent	Centre	Effluent
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	1087	1074	1055	1077
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	5	5	5	4
Chloroform	123	116	108	111
1,2-Dichloroethane	NA	NA	NA	NA
1,1,1-Trichloroethane	191	110	86	75
Benzene	36	6	1	NA
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	21	13	14	14
Trichloroethylene	213	82	52	29
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	447	1588	44	NA
Dibromochloromethane	4	3	3	4
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	86	49	50	50
Ethylbenzene	72	28	10	NA
m,p-xylene	300	90	23	6
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	1	NA	NA	NA
o-xylene	150	49	14	3
Cumene	41	13	5	3
Propylbenzene	129	37	18	6
4-Ethyltoluene	330	71	22	4
3-Ethyltoluene	168	39	13	2
1,3,5-Trimethylbenzene	207	52	18	3
2-Ethyltoluene	125	37	15	3
1,2,4-Trimethylbenzene	499	116	41	8
1,3-Dichlorobenzene	NA	NA	NA	NA
1,4-Dichlorobenzene	92	77	77	91
1,2-Dichlorobenzene	19	12	9	9
1,3-Diethylbenzene	30	5	8	5
1,4-Diethylbenzene	185	37	18	8
1,2-Diethylbenzene	20	5	2	NA

TABLE A17: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY, DAY 2

Compounds	Concentration (ug/m**3)			
	Grit	Aeration Basin		
	Chamber	Influent	Center	Effluent
1,1-Dichloroethylene	2	NA	NA	NA
Dichloromethane	1336	1350	919	998
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	5	5	3	3
Chloroform	366	306	198	206
1,2-Dichloroethane	2	2	NA	NA
1,1,1-Trichloroethane	194	72	39	32
Benzene	58	7	1	1
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	19	20	11	13
Trichloroethylene	110	48	14	9
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	1940	1146	20	NA
Dibromochloromethane	4	5	3	4
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	68	41	34	35
Ethylbenzene	295	117	39	8
m,p-xylene	953	356	99	10
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	1	NA	NA	NA
o-xylene	460	154	39	4
Cumene	96	16	4	3
Propylbenzene	205	38	14	5
4-Ethyltoluene	495	68	16	3
3-Ethyltoluene	206	36	9	1
1,3,5-Trimethylbenzene	271	45	11	2
2-Ethyltoluene	172	34	10	2
1,2,4-Trimethylbenzene	399	95	24	9
1,3-Dichlorobenzene	NA	NA	NA	NA
1,4-Dichlorobenzene	48	83	60	72
1,2-Dichlorobenzene	15	12	8	6
1,3-Diethylbenzene	16	5	1	NA
1,4-Diethylbenzene	166	40	15	6
1,2-Diethylbenzene	37	4	1	NA

TABLE A18: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY, DAY 3

Compounds	Concentration (ug/m**3)		
	Grit	Aeration Basin	
	Chamber	Influent	Centre
1,1-Dichloroethylene	1	NA	NA
Dichloromethane	979	1111	675
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	4	4	2
Chloroform	304	277	168
1,2-Dichloroethane	1	2	NA
1,1,1-Trichloroethane	88	41	24
Benzene	43	6	1
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	23	17	10
Trichloroethylene	82	32	12
1,1,2-Trichloroethane	NA	NA	NA
Toluene	332	902	24
Dibromochloromethane	7	4	3
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	88	32	24
Ethylbenzene	43	24	9
m,p-xylene	173	87	25
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	3	NA	NA
o-xylene	125	61	16
Cumene	43	41	20
Propylbenzene	103	84	45
4-Ethyltoluene	247	134	46
3-Ethyltoluene	123	71	26
1,3,5-Trimethylbenzene	160	69	28
2-Ethyltoluene	91	54	25
1,2,4-Trimethylbenzene	265	126	44
1,3-Dichlorobenzene	NA	NA	NA
1,4-Dichlorobenzene	53	71	50
1,2-Dichlorobenzene	86	52	28
1,3-Diethylbenzene	13	8	3
1,4-Diethylbenzene	95	45	22
1,2-Diethylbenzene	14	6	4

TABLE A19: OFF-GAS CONCENTRATIONS - BURLINGTON SKYWAY, DAY 4

Compounds	Concentration (ug/m**3)		
	Grit	Aeration Basin	
	Chamber	Influent	Centre
1,1-Dichloroethylene	1	NA	NA
Dichloromethane	879	1099	744
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	2	3	2
Chloroform	132	149	95
1,2-Dichloroethane	NA	NA	NA
1,1,1-Trichloroethane	70	38	21
Benzene	39	11	2
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	19	14	9
Trichloroethylene	77	38	17
1,1,2-Trichloroethane	NA	NA	NA
Toluene	312	1225	102
Dibromochloromethane	5	4	2
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	81	38	27
Ethylbenzene	51	22	9
m,p-xylene	183	75	25
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	3	NA	NA
o-xylene	128	51	16
Cumene	77	26	12
Propylbenzene	179	57	32
4-Ethyltoluene	389	89	34
3-Ethyltoluene	172	53	18
1,3,5-Trimethylbenzene	189	48	19
2-Ethyltoluene	106	40	19
1,2,4-Trimethylbenzene	281	91	36
1,3-Dichlorobenzene	NA	NA	NA
1,4-Dichlorobenzene	45	61	46
1,2-Dichlorobenzene	94	87	57
1,3-Diethylbenzene	15	6	2
1,4-Diethylbenzene	106	32	17
1,2-Diethylbenzene	19	6	3

TABLE A20: OFF-GAS CONCENTRATIONS - HIGHLAND CREEK, DAY 1

Compounds	Concentration (ug/m**3)			
	Grit	Aeration Basin		
	Chamber	Influent	Centre	Effluent
1,1-Dichloroethylene	7	NA	NA	NA
Dichloromethane	1004	415	436	NA
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	19	50	54	45
Chloroform	86	115	123	127
1,2-Dichloroethane	NA	NA	NA	NA
1,1,1-Trichloroethane	2256	1593	1640	1573
Benzene	3	NA	NA	2
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	1	NA	NA	NA
Bromodichloroethane	21	17	15	16
Trichloroethylene	69	46	38	33
1,1,2-Trichloroethane	13	11	35	10
Toluene	612	612	86	NA
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	58	86	99	102
Ethylbenzene	62	34	24	13
m,p-xylene	272	82	39	7
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	17	5	26	4
o-xylene	171	48	28	12
Cumene	NA	29	20	10
Propylbenzene	NA	82	61	39
4-Ethyltoluene	4	129	56	13
3-Ethyltoluene	2433	84	47	17
1,3,5-Trimethylbenzene	1090	84	45	14
2-Ethyltoluene	493	44	27	14
1,2,4-Trimethylbenzene	NA	156	68	16
1,3-Dichlorobenzene	4	2	2	2
1,4-Dichlorobenzene	222	132	134	151
1,2-Dichlorobenzene	NA	20	20	20
1,3-Diethylbenzene	NA	12	9	5
1,4-Diethylbenzene	88	46	33	19
1,2-Diethylbenzene	739	8	8	5

TABLE A21: OFF-GAS CONCENTRATIONS - HIGHLAND CREEK, DAY 2

Compounds	Concentration (ug/m**3)			
	Grit	Aeration Basin		
	Chamber	Influent	Centre	Effluent
1,1-Dichloroethylene	23	9	10	18
Dichloromethane	122	NA	628	NA
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	3	78	85	115
Chloroform	4	131	69	173
1,2-Dichloroethane	NA	2	1	3
1,1,1-Trichloroethane	245	3123	2295	3787
Benzene	NA	4	0	3
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	1	NA	1	NA
Bromodichloroethane	3	16	10	16
Trichloroethylene	38	646	370	706
1,1,2-Trichloroethane	NA	25	48	38
Toluene	34	1516	527	273
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	NA	97	85	132
Ethylbenzene	21	93	83	NA
m,p-xylene	53	472	348	493
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	15	28	14
o-xylene	19	195	186	190
Cumene	NA	78	74	88
Propylbenzene	NA	182	170	203
4-Ethyltoluene	826	5	381	398
3-Ethyltoluene	230	186	186	206
1,3,5-Trimethylbenzene	447	230	241	245
2-Ethyltoluene	245	123	134	138
1,2,4-Trimethylbenzene	138	382	363	357
1,3-Dichlorobenzene	179	NA	NA	NA
1,4-Dichlorobenzene	NA	138	147	168
1,2-Dichlorobenzene	27	21	23	24
1,3-Diethylbenzene	NA	30	30	36
1,4-Diethylbenzene	607	106	115	118
1,2-Diethylbenzene	NA	18	21	21

TABLE A22: OFF-GAS CONCENTRATIONS - HIGHLAND CREEK, DAY 3

Compounds	Concentration (ug/m**3)			
	Grit Chamber	Aeration Basin		
		Influent	Centre	Effluent
1,1-Dichloroethylene	61	18	41	38
Dichloromethane	745	733	850	659
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	7	248	298	235
Chloroform	3	94	105	96
1,2-Dichloroethane	NA	1	1	1
1,1,1-Trichloroethane	430	3235	3228	3455
Benzene	NA	0	NA	0
Tetrachloromethane	NA	NA	NA	3
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	1	2	1	NA
Bromodichloroethane	NA	6	5	11
Trichloroethylene	NA	63	57	68
1,1,2-Trichloroethane	34	7	4	15
Toluene	NA	677	292	201
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	NA	103	50	139
Ethylbenzene	0	55	NA	69
m,p-xylene	7	199	134	227
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	16	23	20
o-xylene	7	151	118	162
Cumene	NA	65	14	78
Propylbenzene	NA	159	62	176
4-Ethyltoluene	600	423	378	430
3-Ethyltoluene	175	187	165	186
1,3,5-Trimethylbenzene	357	281	275	296
2-Ethyltoluene	140	124	125	140
1,2,4-Trimethylbenzene	409	462	409	471
1,3-Dichlorobenzene	100	NA	NA	NA
1,4-Dichlorobenzene	15	145	142	172
1,2-Dichlorobenzene	6	9	10	11
1,3-Diethylbenzene	NA	26	27	179
1,4-Diethylbenzene	327	129	133	141
1,2-Diethylbenzene	NA	22	25	26

TABLE A23: OFF-GAS CONCENTRATIONS - HIGHLAND CREEK, DAY 4

Compounds	Grit Chamber	Aeration Basin Influent	Aeration Basin Centre	Aeration Basin Effluent
1,1-Dichloroethylene	74	12	14	16
Dichloromethane	1499	646	659	672
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	45	175	175	181
Chloroform	188	113	114	121
1,2-Dichloroethane	NA	2	2	2
1,1,1-Trichloroethane	2815	2402	2314	2340
Benzene	NA	2	0	2
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	10	10	6	6
Trichloroethylene	745	401	209	199
1,1,2-Trichloroethane	7	14	19	20
Toluene	82	341	103	18
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	NA	40	39	85
Ethylbenzene	24	74	NA	62
m,p-xylene	65	208	151	162
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	1	12	34	16
o-xylene	58	83	70	73
Cumene	NA	40	39	43
Propylbenzene	57	97	91	97
4-Ethyltoluene	838	179	209	157
3-Ethyltoluene	117	78	98	85
1,3,5-Trimethylbenzene	613	165	155	167
2-Ethyltoluene	251	76	74	80
1,2,4-Trimethylbenzene	443	255	216	223
1,3-Dichlorobenzene	129	NA	NA	NA
1,4-Dichlorobenzene	29	116	114	130
1,2-Dichlorobenzene	12	8	8	9
1,3-Diethylbenzene	368	42	18	20
1,4-Diethylbenzene	625	75	70	69
1,2-Diethylbenzene	NA	12	12	13

TABLE A24: OFF-GAS CONCENTRATIONS - LAKEVIEW, DAY 1

Compounds	Grit Chamber	Aeration Basin Influent	Aeration Basin Centre
1,1-Dichloroethylene	NA	NA	NA
Dichloromethane	553	495	344
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	NA	3	3
Chloroform	17	40	33
1,2-Dichloroethane	3	3	3
1,1,1-Trichloroethane	39	167	135
Benzene	2	5	1
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	NA	3	2
Trichloroethylene	NA	7	4
1,1,2-Trichloroethane	NA	NA	NA
Toluene	97	235	76
Dibromochloromethane	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	10	37	NA
Ethylbenzene	18	27	21
m,p-xylene	67	106	72
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA
o-xylene	28	48	9
Cumene	3	3	3
Propylbenzene	11	18	7
4-Ethyltoluene	46	67	56
3-Ethyltoluene	20	35	30
1,3,5-Trimethylbenzene	29	45	43
2-Ethyltoluene	23	936	31
1,2,4-Trimethylbenzene	103	134	101
1,3-Dichlorobenzene	11	NA	NA
1,4-Dichlorobenzene	NA	20	18
1,2-Dichlorobenzene	2	3	3
1,3-Diethylbenzene	6	7	8
1,4-Diethylbenzene	26	30	28
1,2-Diethylbenzene	4	5	4

TABLE A25: OFF-GAS CONCENTRATIONS - LAKEVIEW, DAY 2

Compounds	Concentration (ug/m**3)			
	Grit	Aeration Basin		
	Chamber	Influent	Centre	Effluent
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	606	1045	913	407
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	NA	4	3	NA
Chloroform	14	40	30	13
1,2-Dichloroethane	11	15	11	6
1,1,1-Trichloroethane	24	128	59	15
Benzene	NA	1	NA	NA
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	2	4	3	2
Trichloroethylene	1	12	6	NA
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	152	453	14	NA
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	34	143	71	16
Ethylbenzene	21	61	10	NA
m,p-xylene	78	218	12	NA
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
o-xylene	32	78	9	NA
Cumene	3	6	2	NA
Propylbenzene	10	25	5	2
4-Ethyltoluene	39	83	8	3
3-Ethyltoluene	17	49	3	1
1,3,5-Trimethylbenzene	29	59	6	3
2-Ethyltoluene	19	36	8	6
1,2,4-Trimethylbenzene	92	169	11	NA
1,3-Dichlorobenzene	NA	NA	NA	NA
1,4-Dichlorobenzene	9	32	35	25
1,2-Dichlorobenzene	2	2	3	NA
1,3-Diethylbenzene	7	10	2	2
1,4-Diethylbenzene	29	46	7	5
1,2-Diethylbenzene	4	7	2	NA

TABLE A26: OFF-GAS CONCENTRATIONS - LAKEVIEW, DAY 3

Compounds	Concentration (ug/m**3)			
	Grit Chamber	Aeration Basin Influent	Aeration Basin Centre	Aeration Basin Effluent
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	246	1800	1008	565
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	NA	4	2	NA
Chloroform	NA	50	24	14
1,2-Dichloroethane	5	8	7	6
1,1,1-Trichloroethane	NA	140	29	10
Benzene	NA	4	NA	NA
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	NA	4	2	2
Trichloroethylene	NA	16	3	NA
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	NA	278	6	NA
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	NA	132	42	11
Ethylbenzene	4	90	5	NA
m,p-xylene	165	298	5	NA
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
o-xylene	NA	108	3	NA
Cumene	6	18	NA	NA
Propylbenzene	11	45	2	NA
4-Ethyltoluene	NA	139	5	2
3-Ethyltoluene	21	80	2	NA
1,3,5-Trimethylbenzene	71	99	3	NA
2-Ethyltoluene	42	57	5	NA
1,2,4-Trimethylbenzene	240	243	8	NA
1,3-Dichlorobenzene	20	NA	NA	NA
1,4-Dichlorobenzene	NA	31	24	18
1,2-Dichlorobenzene	15	13	6	NA
1,3-Diethylbenzene	NA	14	NA	NA
1,4-Diethylbenzene	47	59	2	NA
1,2-Diethylbenzene	9	11	NA	NA

TABLE A27: OFF-GAS CONCENTRATIONS - LAKEVIEW, DAY 4

Compounds	Grit Chamber	Aeration Basin Influent	Aeration Basin Centre	Aeration Basin Effluent
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	1001	1405	685	270
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	NA	5	2	NA
Chloroform	22	54	24	10
1,2-Dichloroethane	7	19	13	7
1,1,1-Trichloroethane	125	371	86	27
Benzene	4	6	NA	NA
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	2	5	3	1
Trichloroethylene	10	31	6	NA
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	197	390	8	NA
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	63	141	42	11
Ethylbenzene	90	150	5	4
m,p-xylene	321	474	13	3
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
o-xylene	115	179	7	2
Cumene	5	17	NA	NA
Propylbenzene	24	47	2	NA
4-Ethyltoluene	95	156	4	NA
3-Ethyltoluene	51	83	2	NA
1,3,5-Trimethylbenzene	61	96	1	NA
2-Ethyltoluene	42	61	4	3
1,2,4-Trimethylbenzene	166	210	6	NA
1,3-Dichlorobenzene	NA	NA	3	NA
1,4-Dichlorobenzene	18	27	20	13
1,2-Dichlorobenzene	8	16	9	3
1,3-Diethylbenzene	6	12	NA	NA
1,4-Diethylbenzene	37	35	NA	NA
1,2-Diethylbenzene	12	8	NA	NA

TABLE A28: OFF-GAS CONCENTRATIONS - WATERLOO, DAY 1

Compounds	Concentration (ug/m**3)		
	Aeration Basin		
	Influent	Centre	Effluent
1,1-Dichloroethylene	NA	NA	NA
Dichloromethane	176	168	234
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA
Chloroform	25	23	37
1,2-Dichloroethane	NA	NA	NA
1,1,1-Trichloroethane	9	9	16
Benzene	NA	NA	NA
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	NA	NA	NA
Trichloroethylene	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA
Toluene	25	14	4
Dibromochloromethane	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	5	7	19
Ethylbenzene	2	2	1
m,p-xylene	4	3	NA
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA
o-xylene	1	NA	NA
Cumene	NA	NA	NA
Propylbenzene	NA	1	1
4-Ethyltoluene	4	NA	NA
3-Ethyltoluene	2	NA	NA
1,3,5-Trimethylbenzene	2	2	1
2-Ethyltoluene	9	7	7
1,2,4-Trimethylbenzene	13	5	3
1,3-Dichlorobenzene	NA	NA	NA
1,4-Dichlorobenzene	14	16	22
1,2-Dichlorobenzene	2	2	NA
1,3-Diethylbenzene	NA	NA	NA
1,4-Diethylbenzene	3	NA	NA
1,2-Diethylbenzene	NA	NA	NA

TABLE A29: OFF-GAS CONCENTRATIONS - WATERLOO, DAY 2

Compounds	Concentration (ug/m**3) Aeration Basin Influent	Centre	Effluent
1,1-Dichloroethylene	NA	NA	NA
Dichloromethane	126	67	122
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA
Chloroform	19	9	16
1,2-Dichloroethane	NA	NA	1
1,1,1-Trichloroethane	3	NA	3
Benzene	NA	NA	NA
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	NA	NA	NA
Trichloroethylene	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA
Toluene	21	4	8
Dibromochloromethane	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	364	276	408
Ethylbenzene	NA	NA	NA
m,p-xylene	NA	NA	NA
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA
o-xylene	NA	NA	NA
Cumene	NA	NA	NA
Propylbenzene	NA	NA	NA
4-Ethyltoluene	NA	NA	NA
3-Ethyltoluene	NA	NA	NA
1,3,5-Trimethylbenzene	2	NA	NA
2-Ethyltoluene	7	NA	3
1,2,4-Trimethylbenzene	4	1	1
1,3-Dichlorobenzene	NA	NA	NA
1,4-Dichlorobenzene	12	8	14
1,2-Dichlorobenzene	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA

TABLE A30: OFF-GAS CONCENTRATIONS - WATERLOO, DAY 3

Compounds	Concentration (ug/m**3)		
	Aeration Basin		
	Influent	Centre	Effluent
1,1-Dichloroethylene	NA	NA	NA
Dichloromethane	67	67	72
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA
Chloroform	22	22	25
1,2-Dichloroethane	NA	NA	NA
1,1,1-Trichloroethane	3	NA	2
Benzene	2	NA	NA
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	NA	NA	NA
Trichloroethylene	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA
Toluene	23	19	9
Dibromochloromethane	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	50	56	61
Ethylbenzene	NA	1	NA
m,p-xylene	NA	3	NA
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA
o-xylene	2	NA	NA
Cumene	NA	NA	NA
Propylbenzene	2	NA	NA
4-Ethyltoluene	8	5	NA
3-Ethyltoluene	NA	NA	NA
1,3,5-Trimethylbenzene	5	2	1
2-Ethyltoluene	2	1	NA
1,2,4-Trimethylbenzene	18	9	7
1,3-Dichlorobenzene	NA	1	NA
1,4-Dichlorobenzene	17	17	17
1,2-Dichlorobenzene	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA
1,4-Diethylbenzene	5	2	NA
1,2-Diethylbenzene	NA	NA	NA

TABLE A31: OFF-GAS CONCENTRATIONS - WATERLOO, DAY 4

Compounds	Concentration (ug/m**3)		
	Aeration Basin		
	Influent	Centre	Effluent
1,1-Dichloroethylene	NA	NA	NA
Dichloromethane	18	15	17
trans-1,2-Dichloroethylene	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA
Chloroform	15	12	13
1,2-Dichloroethane	10	8	9
1,1,1-Trichloroethane	2	2	3
Benzene	2	2	NA
Tetrachloromethane	NA	NA	NA
Dibromomethane	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA
Bromodichloroethane	NA	NA	NA
Trichloroethylene	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA
Toluene	15	9	8
Dibromochloromethane	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA
Tetrachloroethylene	19	18	20
Ethylbenzene	NA	NA	NA
m,p-xylene	NA	NA	NA
Bromoform	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA
o-xylene	NA	NA	NA
Cumene	NA	NA	NA
Propylbenzene	NA	NA	NA
4-Ethyltoluene	1	NA	3
3-Ethyltoluene	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA
2-Ethyltoluene	NA	NA	NA
1,2,4-Trimethylbenzene	6	4	4
1,3-Dichlorobenzene	NA	NA	NA
1,4-Dichlorobenzene	15	14	15
1,2-Dichlorobenzene	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA

APPENDIX B

Off-Gas Quality Assurance Data

TABLE B1: FIELD BLANKS - OFF-GAS ANALYSIS

Compounds	Field Blanks - Mass (ng/trap)			
Date of Analysis	(24/06/87)	(29/06/87)	(16/07/87)	(31/07/87)
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	14.0	7.7	NA	NA
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	17.0	NA
Benzene	25.0	8.6	12.0	NA
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	63.0	75.0	76.0	NA
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	NA	NA	NA	NA
Ethylbenzene	NA	NA	6.8	NA
m,p-xylene	NA	NA	16.0	NA
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA
Cumene	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA
4-Ethyltoluene	NA	NA	11.0	NA
3-Ethyltoluene	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA
2-Ethyltoluene	NA	NA	26.0	NA
1,2,4-Trimethylbenzene	5.1	NA	9.7	NA
1,3-Dichlorobenzene	NA	13.0	NA	NA
1,4-Dichlorobenzene	6.7	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA	NA

TABLE B2: PRECISION TEST DATA - BURLINGTON SKYWAY

Compounds	Grit Chamber				
	Duplicates		Mean* Concn (ug/m**3)	Standard Deviation (ug/m**3)	Coeff. of Variation (%)
	#1	#2			
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	1102.6	1072.0	1087.3	21.6	2.0
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	5.7	5.2	5.5	0.3	5.8
Chloroform	126.0	119.9	122.9	4.4	3.5
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	195.1	187.3	191.2	5.6	2.9
Benzene	37.2	34.2	35.7	2.1	5.8
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	22.0	20.6	21.3	1.0	4.5
Trichloroethylene	215.4	209.7	212.6	4.0	1.9
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	449.2	443.8	446.5	3.8	0.8
Dibromochloromethane	4.1	3.7	3.9	0.2	5.8
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	89.4	82.4	85.9	5.0	5.8
Ethylbenzene	73.2	71.2	72.2	1.4	2.0
m,p-xylene	304.9	295.9	300.4	6.4	2.1
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	2.1	1.1	1.5	141.4
o-xylene	150.4	149.8	150.1	0.4	0.3
Cumene	40.7	41.2	40.9	0.4	0.9
Propylbenzene	130.1	127.3	128.7	1.9	1.5
4-Ethyltoluene	333.3	325.8	329.6	5.3	1.6
3-Ethyltoluene	170.7	164.8	167.8	4.2	2.5
1,3,5-Trimethylbenzene	211.4	202.2	206.8	6.5	3.1
2-Ethyltoluene	126.0	123.6	124.8	1.7	1.4
1,2,4-Trimethylbenzene	504.1	494.4	499.2	6.8	1.4
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	93.5	89.9	91.7	2.6	2.8
1,2-Dichlorobenzene	17.5	20.6	19.0	2.2	11.6
1,3-Diethylbenzene	30.5	29.6	30.0	0.6	2.1
1,4-Diethylbenzene	187.0	183.5	185.3	2.5	1.3
1,2-Diethylbenzene	20.3	20.6	20.5	0.2	0.9

* Day 1

TABLE B3: PRECISION TEST DATA - BURLINGTON SKYWAY

Compounds	Aeration Basin - Influent				
	Duplicates		Mean* Concn (ug/m**3)	Standard Deviation (ug/m**3)	Coeff. of Variation (%)
	#1	#2			
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	1429.9	1269.8	1349.9	113.2	8.4
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	5.0	4.9	4.9	0.1	1.8
Chloroform	321.6	291.4	306.5	21.3	7.0
1,2-Dichloroethane	1.7	1.7	1.7	0.0	1.9
1,1,1-Trichloroethane	72.6	70.6	71.6	1.4	1.9
Benzene	7.3	6.7	7.0	0.4	6.4
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	20.7	19.0	19.9	1.2	6.3
Trichloroethylene	49.8	46.4	48.1	2.4	5.1
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	1162.9	1129.1	1146.0	23.8	2.1
Dibromochloromethane	5.6	4.9	5.2	0.5	10.1
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	41.5	39.7	40.6	1.2	3.1
Ethylbenzene	118.3	114.8	116.5	2.5	2.1
m,p-xylene	365.1	346.6	355.9	13.1	3.7
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	157.7	150.1	153.9	5.3	3.5
Cumene	16.0	15.2	15.6	0.5	3.4
Propylbenzene	39.4	37.5	38.5	1.3	3.5
4-Ethyltoluene	68.5	68.4	68.4	0.0	0.0
3-Ethyltoluene	37.3	35.3	36.3	1.4	3.9
1,3,5-Trimethylbenzene	45.6	44.2	44.9	1.1	2.4
2-Ethyltoluene	35.3	33.1	34.2	1.5	4.5
1,2,4-Trimethylbenzene	97.5	92.7	95.1	3.4	3.6
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	85.1	81.7	83.4	2.4	2.9
1,2-Dichlorobenzene	12.9	11.7	12.3	0.8	6.7
1,3-Diethylbenzene	5.4	5.3	5.3	0.1	1.3
1,4-Diethylbenzene	39.4	39.7	39.6	0.2	0.6
1,2-Diethylbenzene	4.6	4.4	4.5	0.1	2.4

* Day 2

TABLE B4: PRECISION TEST DATA - BURLINGTON SKYWAY

Compounds	Aeration Basin - Midpoint				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	700.5	648.9	674.7	36.5	5.4
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	2.2	2.0	2.1	0.2	7.4
Chloroform	173.3	162.1	167.7	7.9	4.7
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	24.4	23.2	23.8	0.9	3.8
Benzene	1.0	1.8	1.4	0.6	40.7
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	10.4	9.3	9.9	0.8	8.5
Trichloroethylene	12.9	10.9	11.9	1.4	11.5
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	16.7	30.5	23.6	9.8	41.5
Dibromochloromethane	2.7	2.9	2.8	0.2	7.1
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	24.4	23.2	23.8	0.9	3.8
Ethylbenzene	8.4	10.5	9.5	1.5	15.5
m,p-xylene	24.4	25.3	24.9	0.6	2.3
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	16.2	16.4	16.3	0.1	0.9
Cumene	20.4	20.4	20.4	0.0	0.1
Propylbenzene	46.7	44.2	45.4	1.7	3.8
4-Ethyltoluene	46.7	46.3	46.5	0.2	0.5
3-Ethyltoluene	26.7	25.3	26.0	1.0	3.8
1,3,5-Trimethylbenzene	28.9	27.4	28.1	1.1	3.8
2-Ethyltoluene	24.4	25.3	24.9	0.6	2.3
1,2,4-Trimethylbenzene	44.4	44.2	44.3	0.2	0.4
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	51.1	48.4	49.8	1.9	3.8
1,2-Dichlorobenzene	28.9	27.4	28.1	1.1	3.8
1,3-Diethylbenzene	3.3	3.4	3.4	0.0	0.7
1,4-Diethylbenzene	22.2	21.1	21.6	0.8	3.8
1,2-Diethylbenzene	4.0	3.4	3.7	0.4	12.1

* Day 3

TABLE B5: PRECISION TEST DATA - HIGHLAND CREEK

Compounds	Grit Chamber Samples				
	Duplicates		Mean* Concn (ug/m**3)	Standard Deviation (ug/m**3)	Coeff. of Variation (%)
	#1	#2			
1,1-Dichloroethylene	9.1	5.6	7.4	2.5	33.7
Dichloromethane	889.7	1119.2	1004.4	162.3	16.2
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	16.3	21.5	18.9	3.7	19.4
Chloroform	60.0	112.1	86.1	36.9	42.9
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	1900.0	2612.9	2256.4	504.1	22.3
Benzene	1.7	3.5	2.6	1.3	49.8
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.4	NA	0.7	1.0	141.4
Bromodichloroethane	16.1	25.7	20.9	6.8	32.6
Trichloroethylene	43.2	95.8	69.5	37.2	53.6
1,1,2-Trichloroethane	NA	25.7	12.9	18.2	141.4
Toluene	545.3	678.5	611.9	94.2	15.4
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	55.2	60.7	58.0	4.0	6.8
Ethylbenzene	67.9	56.8	62.4	7.8	12.6
m,p-xylene	279.1	265.0	272.0	10.0	3.7
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	12.7	20.8	16.8	5.7	34.1
o-xylene	232.6	109.8	171.2	86.8	50.7
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA	NA
4-Ethyltoluene	NA	7.5	3.7	5.3	141.4
3-Ethyltoluene	2589.9	2275.7	2432.8	222.2	9.1
1,3,5-Trimethylbenzene	992.8	1186.9	1089.9	137.3	12.6
2-Ethyltoluene	502.2	484.6	493.4	12.4	2.5
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	8.2	NA	4.1	5.8	NA
1,4-Dichlorobenzene	215.8	229.0	222.4	9.3	4.2
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	131.9	44.4	88.1	61.9	70.2
1,2-Diethylbenzene	726.6	752.3	739.5	18.2	2.5

* Day 1

TABLE B6: PRECISION TEST DATA - HIGHLAND CREEK

Compounds	Grit Chamber Samples				
	Duplicates		Mean* Concn (ug/m**3)	Standard Deviation (ug/m**3)	Coeff. of Variation (%)
	#1	#2			
1,1-Dichloroethylene	77.3	71.0	74.2	4.5	6.0
Dichloromethane	1574.6	1423.5	1499.0	106.8	7.1
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	47.0	43.7	45.3	2.3	5.1
Chloroform	198.9	177.6	188.2	15.1	8.0
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	2923.5	2705.7	2814.6	154.0	5.5
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	14.4	4.6	9.5	6.9	72.3
Trichloroethylene	745.9	743.2	744.5	1.9	0.3
1,1,2-Trichloroethane	8.6	4.6	6.6	2.8	42.0
Toluene	78.5	85.8	82.1	5.2	6.3
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	NA	NA	NA	NA	NA
Ethylbenzene	28.5	18.9	23.7	6.8	28.6
m,p-xylene	125.4	5.2	65.3	85.0	130.2
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	1.8	0.9	1.3	141.4
o-xylene	55.2	60.1	57.7	3.4	6.0
Cumene	NA	NA	NA	NA	NA
Propylbenzene	113.3	NA	56.6	80.1	141.4
4-Ethyltoluene	831.2	844.0	837.6	9.0	1.1
3-Ethyltoluene	NA	235.0	117.5	166.2	141.4
1,3,5-Trimethylbenzene	627.1	598.4	612.7	20.3	3.3
2-Ethyltoluene	224.9	277.0	251.0	36.9	14.7
1,2,4-Trimethylbenzene	759.8	125.8	442.8	448.3	101.3
1,3-Dichlorobenzene	107.7	150.3	129.0	30.1	NA
1,4-Dichlorobenzene	35.9	22.1	29.0	9.7	33.6
1,2-Dichlorobenzene	11.0	13.7	12.4	1.8	14.9
1,3-Diethylbenzene	320.4	415.3	367.9	67.1	18.2
1,4-Diethylbenzene	646.4	603.8	625.1	30.1	4.8
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Day 4

TABLE B7: PRECISION TEST DATA - HIGHLAND CREEK

Compounds	Aeration Basin - Influent				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	16.9	19.2	18.1	1.6	8.9
Dichloromethane	871.7	595.0	733.3	195.7	26.7
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	324.5	171.6	248.0	108.1	43.6
Chloroform	130.8	57.2	94.0	52.0	55.3
1,2-Dichloroethane	1.3	NA	0.6	0.9	141.4
1,1,1-Trichloroethane	3797.3	2673.5	3235.4	794.7	24.6
Benzene	1.0	NA	0.5	0.7	141.4
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	2.3	1.8	2.0	0.3	17.3
Bromodichloroethane	8.2	4.6	6.4	2.6	40.4
Trichloroethylene	75.3	50.3	62.8	17.6	28.1
1,1,2-Trichloroethane	6.3	7.1	6.7	0.6	8.4
Toluene	603.9	749.2	676.5	102.8	15.2
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	94.4	112.1	103.3	12.5	12.1
Ethylbenzene	51.6	57.9	54.8	4.5	8.2
m,p-xylene	172.9	225.2	199.0	37.0	18.6
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	12.3	19.5	15.9	5.0	31.6
o-xylene	138.0	164.8	151.4	18.9	12.5
Cumene	63.0	66.4	64.7	2.4	3.7
Propylbenzene	157.4	160.2	158.8	2.0	1.2
4-Ethyltoluene	423.5	423.1	423.3	0.3	0.1
3-Ethyltoluene	184.0	189.9	187.0	4.2	2.2
1,3,5-Trimethylbenzene	280.9	281.5	281.2	0.4	0.1
2-Ethyltoluene	124.5	124.5	124.5	0.0	0.0
1,2,4-Trimethylbenzene	460.1	464.6	462.4	3.2	0.7
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	147.7	141.9	144.8	4.1	2.8
1,2-Dichlorobenzene	9.4	9.2	9.3	0.2	2.2
1,3-Diethylbenzene	26.6	25.2	25.9	1.0	4.0
1,4-Diethylbenzene	128.3	130.4	129.4	1.5	1.2
1,2-Diethylbenzene	21.3	21.7	21.5	0.3	1.4

* Day 3

TABLE B8: PRECISION TEST DATA - HIGHLAND CREEK

Compounds	Aeration Basin - Midpoint				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	33.1	49.1	41.1	11.3	27.5
Dichloromethane	856.5	842.5	849.5	9.9	1.2
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	306.8	288.3	297.6	13.1	4.4
Chloroform	112.6	98.2	105.4	10.2	9.7
1,2-Dichloroethane	1.1	NA	0.6	0.8	141.4
1,1,1-Trichloroethane	3351.7	3104.9	3228.3	174.5	5.4
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	1.1	0.6	0.8	141.4
Bromodichloroethane	4.2	5.1	4.7	0.6	14.0
Trichloroethylene	64.0	49.1	56.5	10.6	18.7
1,1,2-Trichloroethane	8.6	NA	4.3	6.1	141.4
Toluene	292.3	291.2	291.7	0.8	0.3
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	53.0	47.0	50.0	4.2	8.4
Ethylbenzene	NA	NA	NA	NA	NA
m,p-xylene	140.0	127.6	133.8	8.7	6.5
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	24.3	22.5	23.4	1.3	5.4
o-xylene	123.6	112.5	118.0	7.9	6.7
Cumene	13.2	15.5	14.4	1.6	11.3
Propylbenzene	64.0	59.3	61.7	3.3	5.4
4-Ethyltoluene	388.3	367.9	378.1	14.4	3.8
3-Ethyltoluene	167.8	161.6	164.7	4.4	2.7
1,3,5-Trimethylbenzene	278.1	272.0	275.1	4.4	1.6
2-Ethyltoluene	126.7	123.5	125.1	2.3	1.8
1,2,4-Trimethylbenzene	412.9	405.0	408.9	5.6	1.4
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	143.5	141.1	142.3	1.7	1.2
1,2-Dichlorobenzene	9.3	9.8	9.5	0.4	4.0
1,3-Diethylbenzene	28.7	24.5	26.6	2.9	11.0
1,4-Diethylbenzene	134.7	130.9	132.8	2.7	2.0
1,2-Diethylbenzene	24.3	26.6	25.4	1.6	6.4

* Day 3

TABLE B9: PRECISION TEST DATA - HIGHLAND CREEK

Compounds	Aeration Basin - Effluent				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	17.2	14.4	15.8	1.9	12.2
Dichloromethane	674.2	670.3	672.3	2.8	0.4
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	181.8	179.8	180.8	1.4	0.8
Chloroform	121.2	119.9	120.6	0.9	0.8
1,2-Dichloroethane	2.0	2.1	2.0	0.1	2.6
1,1,1-Trichloroethane	2276.0	2404.1	2340.0	90.6	3.9
Benzene	1.3	1.9	1.6	0.5	28.8
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	5.8	7.1	6.4	0.9	14.0
Trichloroethylene	204.5	193.5	199.0	7.8	3.9
1,1,2-Trichloroethane	20.5	19.1	19.8	1.0	4.9
Toluene	18.7	17.4	18.1	0.9	4.9
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	83.3	87.2	85.3	2.7	3.2
Ethylbenzene	61.4	63.5	62.5	1.5	2.4
m,p-xylene	157.6	167.3	162.4	6.9	4.2
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	16.2	16.6	16.4	0.3	2.0
o-xylene	73.2	73.6	73.4	0.2	0.3
Cumene	42.9	43.6	43.3	0.5	1.1
Propylbenzene	96.0	98.1	97.0	1.5	1.6
4-Ethyltoluene	156.3	157.8	157.0	1.0	0.7
3-Ethyltoluene	98.5	70.8	84.7	19.5	23.1
1,3,5-Trimethylbenzene	164.1	168.9	166.5	3.4	2.0
2-Ethyltoluene	79.3	80.1	79.7	0.6	0.7
1,2,4-Trimethylbenzene	222.3	223.5	222.9	0.9	0.4
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	128.8	130.8	129.8	1.4	1.1
1,2-Dichlorobenzene	8.8	9.0	8.9	0.1	1.2
1,3-Diethylbenzene	19.2	20.2	19.7	0.7	3.5
1,4-Diethylbenzene	70.7	68.1	69.4	1.8	2.6
1,2-Diethylbenzene	13.4	12.3	12.8	0.8	6.2

* Day 4

TABLE B10: PRECISION TEST DATA - LAKEVIEW

Compounds	Aeration Basin - Influent				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	1037.6	1052.1	1044.8	10.2	1.0
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	4.7	4.2	4.4	0.3	7.5
Chloroform	39.4	39.7	39.6	0.2	0.6
1,2-Dichloroethane	14.3	15.7	15.0	1.0	6.5
1,1,1-Trichloroethane	126.7	129.5	128.1	2.0	1.6
Benzene	0.7	1.6	1.2	0.6	53.4
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	3.2	4.0	3.6	0.5	15.2
Trichloroethylene	11.3	13.1	12.2	1.2	10.2
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	448.0	457.7	452.9	6.8	1.5
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	142.9	142.5	142.7	0.2	0.2
Ethylbenzene	59.1	63.1	61.1	2.8	4.6
m,p-xylene	213.0	223.1	218.0	7.1	3.3
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	76.4	79.4	77.9	2.2	2.8
Cumene	5.9	6.1	6.0	0.1	1.9
Propylbenzene	24.6	25.7	25.2	0.8	3.0
4-Ethyltoluene	81.3	84.1	82.7	2.0	2.4
3-Ethyltoluene	49.3	49.1	49.2	0.1	0.3
1,3,5-Trimethylbenzene	59.1	58.4	58.8	0.5	0.8
2-Ethyltoluene	34.8	37.7	36.2	2.0	5.6
1,2,4-Trimethylbenzene	167.5	170.6	169.0	2.2	1.3
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	32.0	32.7	32.4	0.5	1.5
1,2-Dichlorobenzene	NA	3.0	1.5	2.1	141.4
1,3-Diethylbenzene	10.6	10.3	10.4	0.2	2.1
1,4-Diethylbenzene	44.3	46.7	45.5	1.7	3.7
1,2-Diethylbenzene	6.7	6.8	6.7	0.1	1.3

* Day 2

TABLE B11: PRECISION TEST DATA - LAKEVIEW

Compounds	Aeration Basin - Midpoint				
	Duplicates		Mean* Concn (ug/m**3)	Standard Deviation (ug/m**3)	Coeff. of Variation (%)
	#1	#2			
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	1013.8	1002.6	1008.2	7.9	0.8
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	2.4	2.4	2.4	0.0	0.5
Chloroform	24.2	24.4	24.3	0.1	0.5
1,2-Dichloroethane	7.3	7.3	7.3	0.0	0.5
1,1,1-Trichloroethane	29.6	29.3	29.5	0.2	0.6
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	1.9	2.6	2.3	0.5	24.1
Trichloroethylene	3.1	3.9	3.5	0.6	15.8
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	3.1	7.9	5.5	3.4	62.2
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	41.9	42.7	42.3	0.6	1.4
Ethylbenzene	5.5	5.3	5.4	0.2	2.9
m,p-xylene	5.0	5.4	5.2	0.3	5.8
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	2.6	3.0	2.8	0.3	10.1
Cumene	NA	NA	NA	NA	NA
Propylbenzene	2.1	2.2	2.2	0.1	3.2
4-Ethyltoluene	5.5	5.1	5.3	0.3	5.7
3-Ethyltoluene	2.1	2.0	2.1	0.1	3.5
1,3,5-Trimethylbenzene	2.9	2.8	2.9	0.0	0.4
2-Ethyltoluene	5.1	4.7	4.9	0.3	5.7
1,2,4-Trimethylbenzene	8.4	7.9	8.1	0.3	3.8
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	24.2	24.4	24.3	0.1	0.5
1,2-Dichlorobenzene	5.5	5.9	5.7	0.3	4.8
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	2.6	2.2	2.4	0.3	11.8
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Day 3

TABLE B12: PRECISION TEST DATA - LAKEVIEW

Compounds	Aeration Basin - Effluent				
	Duplicates		Mean* Concn (ug/m**3)	Standard Deviation (ug/m**3)	Coeff. of Variation (%)
	#1	#2			
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	274.7	266.1	270.4	6.1	2.3
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	10.5	10.4	10.5	0.1	0.7
1,2-Dichloroethane	7.5	6.6	7.0	0.6	8.2
1,1,1-Trichloroethane	27.3	27.1	27.2	0.1	0.5
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	1.2	0.6	0.8	141.4
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	11.0	10.7	10.8	0.2	2.0
Ethylbenzene	3.3	3.8	3.5	0.4	10.0
m,p-xylene	2.8	4.0	3.4	0.8	24.6
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	1.6	2.6	2.1	0.7	35.7
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA	NA
4-Ethyltoluene	NA	NA	NA	NA	NA
3-Ethyltoluene	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
2-Ethyltoluene	3.1	3.4	3.3	0.2	5.5
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	13.2	13.0	13.1	0.1	0.7
1,2-Dichlorobenzene	3.3	3.1	3.2	0.1	4.6
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Day 4

TABLE B13: PRECISION TEST DATA - WATERLOO

Compounds	Aeration Basin - Influent				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	180.4	172.5	176.5	5.6	3.2
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	25.8	25.0	25.4	0.5	2.2
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	8.2	9.3	8.7	0.7	8.1
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	25.8	24.3	25.0	1.1	4.3
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	4.6	5.0	4.8	0.3	5.3
Ethylbenzene	2.1	2.0	2.0	0.0	2.2
m,p-xylene	4.1	4.0	4.1	0.1	2.2
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	1.8	NA	0.9	1.2	141.4
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA	NA
4-Ethyltoluene	3.4	3.8	3.6	0.3	8.0
3-Ethyltoluene	1.6	2.5	2.1	0.6	30.1
1,3,5-Trimethylbenzene	2.1	2.3	2.2	0.1	5.9
2-Ethyltoluene	8.8	8.8	8.8	0.0	0.1
1,2,4-Trimethylbenzene	12.6	13.0	12.8	0.3	2.0
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	13.9	13.5	13.7	0.3	2.2
1,2-Dichlorobenzene	2.4	2.5	2.4	0.1	2.3
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	2.6	2.8	2.7	0.1	4.6
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Day 1

TABLE B14: PRECISION TEST DATA - WATERLOO

Compounds	Aeration Basin - Influent				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	17.9	19.0	18.5	0.8	4.1
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	15.8	15.1	15.5	0.5	3.2
1,2-Dichloroethane	10.1	9.4	9.8	0.5	5.5
1,1,1-Trichloroethane	2.6	2.1	2.4	0.3	14.0
Benzene	1.9	2.7	2.3	0.6	27.1
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	17.0	13.7	15.4	2.3	15.0
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	18.9	18.5	18.7	0.2	1.3
Ethylbenzene	NA	NA	NA	NA	NA
m,p-xylene	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA	NA
4-Ethyltoluene	1.7	NA	0.9	1.2	141.4
3-Ethyltoluene	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
2-Ethyltoluene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	5.9	5.7	5.8	0.1	2.1
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	14.6	14.4	14.5	0.1	1.0
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Day 4

TABLE B15: PRECISION TEST DATA - WATERLOO

Compounds	Aeration Basin - Midpoint				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	69.1	65.1	67.1	2.8	4.2
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	22.8	21.9	22.3	0.7	3.0
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	18.4	19.5	19.0	0.8	4.1
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	57.6	53.5	55.5	2.9	5.2
Ethylbenzene	1.5	NA	0.7	1.0	141.4
m,p-xylene	3.2	3.3	3.2	0.0	0.7
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA	NA
4-Ethyltoluene	5.5	5.3	5.4	0.1	2.4
3-Ethyltoluene	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	2.0	2.1	2.0	0.1	3.9
2-Ethyltoluene	1.3	1.6	1.5	0.2	16.4
1,2,4-Trimethylbenzene	8.8	9.1	8.9	0.2	2.5
1,3-Dichlorobenzene	2.8	NA	1.4	2.0	141.4
1,4-Dichlorobenzene	17.3	16.5	16.9	0.5	3.2
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	NA	3.0	1.5	2.1	141.4
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Day 3

TABLE B16: PRECISION TEST DATA - WATERLOO

Compounds	Aeration Basin - Effluent				
	Duplicates		Mean* Concn	Standard Deviation	Coeff. of Variation
	#1	#2	(ug/m**3)	(ug/m**3)	(%)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	120.3	123.4	121.8	2.2	1.8
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	16.0	16.1	16.1	0.1	0.3
1,2-Dichloroethane	NA	1.4	0.7	1.0	141.4
1,1,1-Trichloroethane	3.1	3.3	3.2	0.2	5.0
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	9.1	7.3	8.2	1.3	15.6
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	414.3	401.7	408.0	8.9	2.2
Ethylbenzene	NA	NA	NA	NA	NA
m,p-xylene	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA	NA
4-Ethyltoluene	NA	NA	NA	NA	NA
3-Ethyltoluene	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
2-Ethyltoluene	5.3	NA	2.7	3.8	141.4
1,2,4-Trimethylbenzene	1.6	1.3	1.5	0.2	14.8
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	13.6	14.0	13.8	0.3	2.2
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Day 2

TABLE B17: BREAKTHROUGH TEST DATA - BURLINGTON SKYWAY WPCP

Compounds	Percent Recovered on Backup Trap			
	Day 2	Day 3	Day 4	Average
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	10.36	0.50	3.55	4.80
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA
Chloroform	NA	NA	2.67	0.89
1,2-Dichloroethane	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	7.56	2.52
Benzene	NA	NA	6.40	2.13
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA
Trichloroethylene	NA	NA	1.88	0.63
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	NA	NA	9.57	3.19
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	NA	NA	NA	NA
Ethylbenzene	NA	NA	8.40	2.80
m,p-xylene	NA	NA	6.52	2.17
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
o-xylene	NA	NA	8.68	2.89
Cumene	NA	NA	NA	NA
Propylbenzene	NA	NA	4.22	1.41
4-Ethyltoluene	NA	0.40	4.54	1.65
3-Ethyltoluene	NA	NA	5.37	1.79
1,3,5-Trimethylbenzene	NA	NA	3.78	1.26
2-Ethyltoluene	NA	NA	4.03	1.34
1,2,4-Trimethylbenzene	NA	NA	5.58	1.86
1,3-Dichlorobenzene	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	12.13	4.04
1,2-Dichlorobenzene	NA	NA	4.97	1.66
1,3-Diethylbenzene	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	4.58	1.53
1,2-Diethylbenzene	NA	NA	NA	NA

TABLE B18: BREAKTHROUGH TEST DATA - HIGHLAND CREEK WPCP

Compounds	Percent Recovered on Backup Trap				
	Day 1	Day 2	Day 3	Day 4	Average
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	0.54	NA	1.47	NA	0.50
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	35.64	NA	8.91
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.68	16.85	32.05	0.45	12.51
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	3.78	NA	4.56	2.09
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	NA	NA	100.00	NA	25.00
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	100.00	NA	25.00
m,p-xylene	NA	NA	11.11	NA	2.78
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	NA	NA	23.81	NA	NA
Cumene	NA	NA	100.00	NA	NA
Propylbenzene	100.00	100.00	100.00	NA	75.00
4-Ethyltoluene	51.52	0.59	1.35	0.42	13.47
3-Ethyltoluene	0.06	1.96	NA	NA	0.51
1,3,5-Trimethylbenzene	0.37	0.78	1.57	0.44	0.79
2-Ethyltoluene	NA	0.44	1.29	0.29	0.51
1,2,4-Trimethylbenzene	100.00	4.55	1.98	5.40	27.98
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	5.94	0.40	0.83	0.41	1.89
1,2-Diethylbenzene	NA	NA	100.00	100.00	50.00

TABLE B19: BREAKTHROUGH TEST DATA - LAKEVIEW WPCP

Compounds	Percent Recovered on Backup Trap			
	Day 1	Day 2	Day 4	Average
1,1-Dichloroethylene	NA	NA	NA	NA
Dichloromethane	NA	NA	NA	NA
trans-1,2-Dichloroethylene	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA
Benzene	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA
Toluene	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA
Tetrachloroethylene	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA
m,p-xylene	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA
Cumene	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA
4-Ethyltoluene	3.85	NA	NA	1.28
3-Ethyltoluene	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA
2-Ethyltoluene	17.23	NA	NA	5.74
1,2,4-Trimethylbenzene	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA	NA

TABLE B20: BREAKTHROUGH TEST DATA - WATERLOO WPCP

Compounds	Percent Recovered on Backup Trap				
	Day 1	Day 2	Day 3	Day 4	Average
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	NA	NA	NA	NA	NA
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	6.10	NA	10.48	24.21	10.20
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA
m,p-xylene	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA
Propylbenzene	NA	NA	NA	NA	NA
4-Ethyltoluene	NA	NA	NA	NA	NA
3-Ethyltoluene	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
2-Ethyltoluene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	NA	NA	NA	NA	NA
1,2-Diethylbenzene	NA	NA	NA	NA	NA

TABLE B21: POOLED COEFFICIENTS OF VARIATION - OFF-GAS ANALYSES

Compounds	Off-Gas Analyses Pooled Coefficients of Variation*				
	Skyway	Highland Creek	Lakeview	Waterloo	Total Estimate
1,1-Dichloroethylene	NA	21.1	NA	NA	21.1
Dichloromethane	5.9	14.5	1.5	3.5	9.0
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	5.5	22.2	5.4	NA	16.1
Chloroform	5.3	33.3	0.6	2.5	19.4
1,2-Dichloroethane	1.9	2.6	6.1	5.5	5.0
1,1,1-Trichloroethane	3.0	15.5	1.0	9.8	10.4
Benzene	24.7	42.2	56.2	27.4	36.4
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	17.3	NA	0.0	7.8
Bromodichloroethane	6.6	43.8	20.3	NA	32.5
Trichloroethylene	7.4	29.5	13.4	NA	22.1
1,1,2-Trichloroethane	NA	25.6	NA	NA	25.6
Toluene	24.7	10.3	47.2	11.2	22.9
Dibromochloromethane	7.9	NA	NA	NA	7.9
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	4.4	8.3	1.4	3.9	5.3
Ethylbenzene	9.1	16.4	6.6	2.2	11.5
m,p-xylene	2.8	101.1	14.8	1.6	63.1
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	23.9	NA	NA	23.9
o-xylene	2.1	24.7	21.9	NA	20.2
Cumene	2.0	6.9	1.9	NA	4.8
Propylbenzene	3.1	3.3	3.1	NA	3.2
4-Ethyltoluene	1.0	2.0	4.4	5.9	3.4
3-Ethyltoluene	3.5	12.6	2.5	30.5	12.7
1,3,5-Trimethylbenzene	3.2	6.0	0.7	5.0	4.6
2-Ethyltoluene	3.0	6.8	5.6	11.6	6.9
1,2,4-Trimethylbenzene	2.2	63.6	2.9	7.7	35.6
1,3-Dichlorobenzene	NA	23.5	NA	NA	23.5
1,4-Dichlorobenzene	3.2	15.5	1.0	2.3	9.1
1,2-Dichlorobenzene	8.0	7.9	4.7	2.3	7.0
1,3-Diethylbenzene	1.5	11.0	2.1	NA	7.9
1,4-Diethylbenzene	2.4	34.5	8.8	4.6	23.7
1,2-Diethylbenzene	6.9	4.6	1.0	NA	5.4
Total Pooled Estimate	8.4	31.2	14.4	8.6	21.5

* Pooled across all sampling locations; Assumption: samples are from a population with the same CVs where sample means may be different

TABLE B22: POOLED COEFFICIENTS OF VARIATION - OFF-GAS ANALYSES

Compounds	Off-Gas Analyses Pooled Coefficients of Variation*				
	Grit	Aeration Basin			Total
	Chamber	Influent	Midpoint	Effluent	Estimate
1,1-Dichloroethylene	24.6	8.9	27.8	12.2	21.1
Dichloromethane	10.3	12.9	3.5	1.7	9.0
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	12.1	26.4	5.0	0.8	16.1
Chloroform	26.1	26.4	5.6	0.6	19.4
1,2-Dichloroethane	NA	5.0	0.5	6.1	5.0
1,1,1-Trichloroethane	13.5	13.3	3.8	3.7	10.4
Benzene	37.0	36.3	41.9	29.2	36.4
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	10.0	0.0	0.0	7.8
Bromodichloroethane	50.0	25.8	16.9	14.0	32.5
Trichloroethylene	32.6	17.7	15.7	3.9	22.1
1,1,2-Trichloroethane	43.3	8.4	NA	4.9	25.6
Toluene	9.7	9.8	39.7	11.6	22.9
Dibromochloromethane	5.8	10.1	7.1	NA	7.9
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	6.3	6.1	5.4	2.5	5.3
Ethylbenzene	18.3	4.9	11.2	7.3	11.5
m,p-xylene	130.0	9.7	4.5	17.8	63.1
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	34.8	32.1	5.4	2.0	23.9
o-xylene	30.8	7.7	7.0	25.8	20.2
Cumene	0.9	3.1	8.0	1.1	4.8
Propylbenzene	1.5	2.8	4.2	1.6	3.2
4-Ethyltoluene	1.4	4.2	3.6	0.7	3.4
3-Ethyltoluene	6.7	15.4	3.4	23.3	12.7
1,3,5-Trimethylbenzene	7.8	3.2	2.8	2.0	4.6
2-Ethyltoluene	8.7	3.6	8.8	3.9	6.9
1,2,4-Trimethylbenzene	89.9	2.2	2.4	10.5	35.6
1,3-Dichlorobenzene	23.5	NA	NA	NA	23.5
1,4-Dichlorobenzene	20.0	2.2	2.6	1.5	9.1
1,2-Dichlorobenzene	13.4	4.3	4.2	3.4	7.0
1,3-Diethylbenzene	13.1	2.7	7.8	3.5	7.9
1,4-Diethylbenzene	44.5	3.0	7.3	2.6	23.7
1,2-Diethylbenzene	1.9	2.1	9.3	6.1	5.4
Total Pooled Estimate	39.1	13.4	12.5	9.9	21.5

* Pooled across all four treatment plants; Assumption: samples are from a population with the same CVs where sample means may be different

APPENDIX C

Sampling Chamber Air Flow Data

TABLE C1: SAMPLING CHAMBER AIR FLOW RATE DATA - BURLINGTON SKYWAY WPCP

DAY	Sampling Chamber Air Flowrate (m**3/h)			
	Grit Chamber	Aeration Basin		
		Influent	Centre	Effluent
1	3.2	47.6	39.1	42.5
2	3.2	45.0	32.3	47.6
3	3.2	45.0	33.1	45.9
4	3.4	45.0	32.3	45.0
5	3.7	45.0	32.3	45.0
Average	3.4	45.5	33.8	45.2

TABLE C2: SAMPLING CHAMBER AIR FLOW RATE DATA - HIGHLAND CREEK WPCP

DAY	Sampling Chamber Air Flowrate (m**3/h)			
	Grit	Aeration Basin		
	Chamber	Influent	Centre	Effluent
1	28.9	5.4	2.9	3.9
2	29.7	5.4	2.9	4.2
3	28.9	5.6	2.9	4.2
4	28.9	5.4	2.9	4.6
5	28.9	5.4	2.9	4.8
Average	29.1	5.5	2.9	4.3

TABLE C3: SAMPLING CHAMBER AIR FLOW RATE DATA - LAKEVIEW WPCP

DAY	Sampling Chamber Air Flowrate (m**3/h)			
	Grit Chamber	Aeration Basin		
		Influent	Centre	Effluent
1	< 1.09	< 1.09	< 1.09	< 1.09
2	< 1.09	3.4	1.1	< 1.09
3	< 1.09	6.8	9.3	8.5
4	< 1.09	7.6	9.7	8.5
5	< 1.09	7.6	9.3	9.3
Average*	< 1.09	5.2	6.0	5.5

* Assumed < 1.09 = 0.545

TABLE C4: SAMPLING CHAMBER AIR FLOW RATE DATA - WATERLOO WPCP

DAY	Sampling Chamber Air Flowrate (m**3/h)			
	Grit* Chamber	Aeration Basin		
		Influent	Centre	Effluent
1	NA	2.0	3.4	3.4
2	NA	2.0	3.7	3.4
3	NA	2.0	3.7	3.4
4	NA	2.0	4.6	3.7
5	NA	2.0	4.1	3.7
Average	NA	2.0	3.9	3.5

* Grit chamber not aerated

APPENDIX D

Plant Operating and Design Data

TABLE D.1: TREATMENT DATA – SKYWAY WPCP

Period: June 22–26, 1987

Parameter	(units)	22	23	24	25	26	Ave.
Aeration Basin:							
MLSS	(mg/L)	–	3057	–	3506	3286	3283
MLVSS	(%)	–	75	–	78	–	77
MLVSS	(mg/L)	–	2293	–	2735	–	2514
DO*	(mg/L)	1.5	1.5	1.3	1.2	1.2	1.4
SRT	(days)	–	8.3	–	8.8	7.9	8.3
Sludge Wasting	(m^3/d)	1841	1845	2012	2038	2014	1950
RAS SS	(mg/L)	–	–	–	–	–	9800
Sludge Wasting	(kg/d)	18042	18081	19718	19972	19737	19110
Temperature	(°C)	–	–	–	–	–	–
Raw Wastewater:							
Temperature	(°C)	–	–	–	–	–	–
Plant Effluent:							
SS	(mg/L)	–	–	–	–	–	4.0
Flow	(m^3/d)	97000	75000	67000	71000	69000	75800

* aeration basin effluent

TABLE D.2: TREATMENT DATA – HIGHLAND CREEK WPCP*

Period: June 29 – JULY 3, 1987

Parameter	(units)	29	30	1	2	3	Ave.
Aeration Basin:							
MLSS	(mg/L)	4171	4278	–	4332	4271	4263
MLVSS	(%)	–	–	–	–	–	–
MLVSS	(mg/L)	–	–	–	–	–	–
DO**	(mg/L)	2.6	2.6	–	3.1	3.4	2.9
SRT	(days)	–	–	–	–	–	–
Sludge Wasting	(m^3/d)	540	710	540	410	470	530
RAS SS	(mg/L)	–	–	–	–	–	–
Sludge Wasting	(kg/d)	–	–	–	–	–	–
Temperature	(°C)	–	–	–	–	–	–
Raw Wastewater:							
Temperature	(°C)	–	–	–	–	–	–
Plant Effluent:							
SS	(mg/L)	15	12	14	15	8	13
Flow	(m^3/d)	77900	79400	78500	77300	78400	78300

* old plant only
** aeration basin average

TABLE D.3: TREATMENT DATA – LAKEVIEW WPCP*

Period: July 13–17, 1987

Parameter	(units)	13	14	15	16	17	Ave.
Aeration Basin:							
MLSS	(mg/L)	–	1720	1750	2450	2750	2170
MLVSS	(%)	–	–	–	–	–	72
MLVSS	(mg/L)	–	–	–	–	–	1550
DO**	(mg/L)	–	3.6	7.0	6.2	6.6	5.9
SRT	(days)	–	–	–	–	–	5.5
Sludge Wasting	(m^3/d)	940	940	940	940	940	940
RAS SS	(mg/L)	–	5195	3630	6000	3650	4620
Sludge Wasting	(kg/d)	–	4883	3412	5640	3431	4343
Temperature	(°C)	–	–	–	–	–	–
Raw Wastewater:							
Temperature	(°C)	–	–	–	–	–	–
Plant Effluent:							
SS	(mg/L)	49	125	5	42	76	59
Flow	(m^3/d)	45740	82820	54750	69360	68970	64330

* plant 3 only
** aeration basin – final pass

TABLE D.4: TREATMENT DATA – WATERLOO WPCP*

Period: July 20–24, 1987

Parameter	(units)	20	21	22	23	24	Ave.
Aeration Basin:							
MLSS	(mg/L)	1750	1960	2040	2170	2120	2010
MLVSS	(%)	–	–	–	–	–	–
MLVSS	(mg/L)	–	–	–	–	–	1160
DO**	(mg/L)	2.6	1.9	1.9	2.7	3.2	2.5
SRT	(days)	5.2	5.9	5.9	6.6	6.1	5.9
Sludge Wasting	(m^3/d)	409	409	409	409	409	409
RAS SS	(mg/L)	5580	5770	6120	5820	6000	5860
Sludge Wasting	(kg/d)	2282	2360	2503	2380	2454	2397
Temperature	(°C)	–	–	–	–	–	22
Raw Wastewater:							
Temperature	(°C)	–	–	–	–	–	20
Flow	(m^3/d)	31600	29250	26050	24800	33350	29010
Plant Effluent:							
SS	(mg/L)	9	6	6	5	6	6

* old plant only
** aeration basin influent

APPENDIX E

VOC Emission Rate Data

[illegible]

[illegible] 20–24, 19[illegible]

Parameter	Units	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Ave.
[illegible]							
MLSS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2010
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1100
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.9
Sludge Wasting	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5580
Sludge Wasting	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2307
Temperature	[illegible]						22
[illegible]							
[illegible]	[illegible]						20
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	33,380	28010
[illegible]							
[illegible]	[illegible]					8	[illegible]

TABLE E1: ESTIMATED VOC EMISSION RATES - BURLINGTON SKYWAY WPCP

Compounds	GRIT CHAMBER* Estimated Mass Flux (mg/d.m**2)	GRIT CHAMBER* Estimated Emission Rate (g/d)	AERATION SECTION** Estimated Mass Flux (mg/d.m**2)	AERATION SECTION** Estimated Emission Rate (g/d)	TOTAL Estimated Emission Rate (g/d)
1,1-Dichloroethylene	0.05	0.01	NA	NA	0.01
Dichloromethane	44.65	6.64	324.41	1245.74	1252.37
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.18	0.03	1.12	4.30	4.33
Chloroform	9.64	1.43	54.64	209.82	211.25
1,2-Dichloroethane	0.03	0.01	0.09	0.33	0.34
1,1,1-Trichloroethane	5.67	0.84	17.15	65.84	66.69
Benzene	1.83	0.27	0.96	3.69	3.96
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	0.85	0.13	4.31	16.54	16.67
Trichloroethylene	5.01	0.74	9.88	37.94	38.69
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	31.59	4.70	134.56	516.70	521.39
Dibromochloromethane	0.20	0.03	1.15	4.40	4.43
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	3.36	0.50	12.43	47.72	48.22
Ethylbenzene	4.80	0.71	7.28	27.97	28.69
m,p-xylene	16.79	2.49	21.61	82.98	85.47
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	0.08	0.01	NA	NA	0.01
o-xylene	8.99	1.34	11.01	42.27	43.61
Cumene	2.68	0.40	3.92	15.05	15.44
Propylbenzene	6.42	0.95	9.27	35.59	36.54
4-Ethyltoluene	15.23	2.26	13.21	50.74	53.00
3-Ethyltoluene	6.97	1.04	7.24	27.79	28.83
1,3,5-Trimethylbenzene	8.62	1.28	8.01	30.78	32.06
2-Ethyltoluene	5.16	0.77	6.49	24.92	25.69
1,2,4-Trimethylbenzene	15.05	2.24	16.12	61.90	64.14
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	2.47	0.37	22.70	87.15	87.52
1,2-Dichlorobenzene	2.22	0.33	7.89	30.28	30.61
1,3-Diethylbenzene	0.77	0.11	1.29	4.95	5.07
1,4-Diethylbenzene	5.76	0.86	6.75	25.92	26.78
1,2-Diethylbenzene	0.94	0.14	0.83	3.20	3.34

* Includes 2 grit chambers (12.2m x 6.1m); Emissions based on an air flowrate of 0.99*1,240,000 m3/d

**Includes 6 aeration basins (80m x 8m); Emissions based on a air flowrate of 0.005*1,240,000 m3/d

TABLE E2: ESTIMATED VOC EMISSION RATES - HIGHLAND CREEK WPCP

Compounds	GRIT CHAMBER* Estimated Mass Flux (mg/d.m**2)	GRIT CHAMBER* Estimated Emission Rate (g/d)	AERATION SECTION** Estimated Mass Flux (mg/d.m**2)	AERATION SECTION** Estimated Emission Rate (g/d)	TOTAL Estimated Emission Rate (g/d)
1,1-Dichloroethylene	2.33	0.84	1.97	10.00	10.84
Dichloromethane	47.42	17.18	64.21	325.47	342.65
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	1.04	0.38	19.60	99.37	99.75
Chloroform	3.95	1.43	15.56	78.86	80.29
1,2-Dichloroethane	NA	NA	0.16	0.80	0.80
1,1,1-Trichloroethane	80.84	29.29	349.16	1769.84	1799.13
Benzene	0.04	0.01	0.16	0.81	0.83
Tetrachloromethane	NA	NA	0.04	0.19	0.19
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	0.05	0.02	0.04	0.21	0.23
Bromodichloroethane	0.46	0.17	1.53	7.76	7.93
Trichloroethylene	11.99	4.34	31.95	161.95	166.29
1,1,2-Trichloroethane	0.75	0.27	2.77	14.06	14.33
Toluene	10.24	3.71	52.35	265.36	269.07
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	0.82	0.30	11.92	60.40	60.69
Ethylbenzene	1.51	0.55	5.73	29.03	29.58
m,p-xylene	5.59	2.02	28.42	144.08	146.10
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	0.25	0.09	2.40	12.15	12.24
o-xylene	3.59	1.30	14.85	75.27	76.56
Cumene	NA	NA	6.50	32.95	32.95
Propylbenzene	0.80	0.29	15.99	81.03	81.32
4-Ethyltoluene	31.90	11.56	31.10	157.65	169.21
3-Ethyltoluene	41.58	15.07	17.18	87.10	102.16
1,3,5-Trimethylbenzene	35.26	12.78	24.77	125.54	138.32
2-Ethyltoluene	15.88	5.75	12.39	62.80	68.55
1,2,4-Trimethylbenzene	13.93	5.05	38.07	192.98	198.03
1,3-Dichlorobenzene	5.80	2.10	0.07	0.35	2.45
1,4-Dichlorobenzene	3.75	1.36	19.02	96.38	97.74
1,2-Dichlorobenzene	0.63	0.23	2.05	10.37	10.60
1,3-Diethylbenzene	5.18	1.88	4.87	24.68	26.55
1,4-Diethylbenzene	23.18	8.40	11.89	60.26	68.66
1,2-Diethylbenzene	10.40	3.77	2.14	10.87	14.64

* Includes 5 grit chambers (18.3m x 3.96m); Emissions based on an air flowrate of 4078.08 m3/d/chamber

**Includes 8 aeration tanks (36m x 17.6m); Emissions based on an air flowrate of 85680 m3/d/tank

TABLE E3: ESTIMATED VOC EMISSION RATES - LAKEVIEW WPCP

Compounds	GRIT CHAMBER* Estimated Mass Flux (mg/d.m**2)	GRIT CHAMBER* Estimated Emission Rate (g/d)	AERATION SECTION** Estimated Mass Flux (mg/d.m**2)	AERATION SECTION** Estimated Emission Rate (g/d)	TOTAL Estimated Emission Rate (g/d)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	25.70	4.51	721.38	2316.09	2320.61
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	2.09	6.71	6.71
Chloroform	0.57	0.10	26.51	85.10	85.20
1,2-Dichloroethane	0.28	0.05	8.07	25.92	25.97
1,1,1-Trichloroethane	2.00	0.35	91.44	293.58	293.93
Benzene	0.07	0.01	1.27	4.09	4.10
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	0.04	0.01	2.41	7.72	7.73
Trichloroethylene	0.12	0.02	6.62	21.26	21.29
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	4.78	0.84	112.51	361.22	362.06
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	1.15	0.20	50.78	163.04	163.24
Ethylbenzene	1.42	0.25	28.72	92.20	92.45
m,p-xylene	6.74	1.18	92.79	297.93	299.11
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	1.86	0.33	34.21	109.83	110.16
Cumene	0.18	0.03	3.74	12.02	12.05
Propylbenzene	0.60	0.11	11.87	38.11	38.21
4-Ethyltoluene	1.93	0.34	40.46	129.90	130.24
3-Ethyltoluene	1.17	0.21	22.05	70.78	70.99
1,3,5-Trimethylbenzene	2.03	0.36	27.46	88.18	88.53
2-Ethyltoluene	1.34	0.24	88.68	284.71	284.94
1,2,4-Trimethylbenzene	6.43	1.13	67.98	218.26	219.38
1,3-Dichlorobenzene	0.33	0.06	0.21	0.69	0.75
1,4-Dichlorobenzene	0.28	0.05	21.72	69.74	69.79
1,2-Dichlorobenzene	0.30	0.05	4.48	14.40	14.45
1,3-Diethylbenzene	0.20	0.04	4.34	13.94	13.97
1,4-Diethylbenzene	1.48	0.26	16.41	52.70	52.96
1,2-Diethylbenzene	0.30	0.05	2.74	8.81	8.86

* Includes 1 grit chamber (27.4m x 6.4m); Emissions based on an air flowrate of 0.005*3,001,600 m3/d

**Includes 1 aeration basin with 4 passes (131.7m x 6.1m x 4 passes); Emissions based on an air flowrate of 0.99*3,001,600 m3/d

TABLE E4: ESTIMATED VOC EMISSION RATES - WATERLOO WPCP

Compounds	Activated Sludge Aeration Section*				
	Average Concentration (ug/m**3)			Estimated Mass Flux	Estimated Emission
	Influent	Midpoint	Effluent	(mg/d.m**2)	Rate (g/d)
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	97	79	111	12.42	15.23
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
Chloroform	21	17	23	2.61	3.20
1,2-Dichloroethane	2	2	2	0.30	0.36
1,1,1-Trichloroethane	4	3	6	0.56	0.68
Benzene	1	0	NA	0.07	0.08
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
Bromodichloroethane	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	21	11	7	1.73	2.12
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	109	89	127	14.07	17.26
Ethylbenzene	1	1	0	0.06	0.08
m,p-xylene	1	1	NA	0.11	0.13
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	1	NA	NA	0.03	0.03
Cumene	NA	NA	NA	NA	NA
Propylbenzene	1	0	0	0.05	0.07
4-Ethyltoluene	3	1	1	0.23	0.29
3-Ethyltoluene	1	NA	NA	0.02	0.03
1,3,5-Trimethylbenzene	2	1	1	0.16	0.19
2-Ethyltoluene	4	2	2	0.38	0.47
1,2,4-Trimethylbenzene	10	5	4	0.79	0.97
1,3-Dichlorobenzene	NA	0	NA	0.01	0.02
1,4-Dichlorobenzene	14	14	17	1.94	2.38
1,2-Dichlorobenzene	1	1	NA	0.05	0.06
1,3-Diethylbenzene	NA	NA	NA	NA	NA
1,4-Diethylbenzene	2	0	NA	0.10	0.12
1,2-Diethylbenzene	NA	NA	NA	NA	NA

* Includes 4 aeration basins (40.2m x 7.6m); Emissions based on an air flowrate of 159,000 m3/d

APPENDIX F

Wastewater Concentration Data

TABLE F1: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, GRIT CHAMBER

Compounds	M.D.L. *	Concentration (ug/L) Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	5.2	15.7	10.2	5.5	7.9	8.9
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.3	NA	NA	NA	NA	0.1
Chloroform	0.5	3.3	4.9	4.0	2.9	4.0	3.8
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	2.2	0.8	1.0	0.6	0.5	1.0
Benzene	0.5	NA	0.3	NA	0.2	0.3	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	0.3	NA	NA	NA	NA	0.1
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	0.2	NA	NA	0.0
Trichloroethylene	0.5	2.6	2.3	1.2	0.8	1.4	1.7
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	5.5	2.8	4.2	2.4	2.9	3.6
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	3.1	0.8	1.3	1.1	1.0	1.5
Ethylbenzene	0.5	0.3	0.3	0.4	NA	0.3	0.3
m,p-xylene	0.5	2.0	2.2	2.1	0.7	1.8	1.8
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	2.5	1.6	2.5	0.7	2.3	1.9
Cumene	0.2	0.5	NA	0.8	NA	1.0	0.5
Propylbenzene	0.2	1.1	0.2	1.9	0.2	2.3	1.1
3&4-Ethyltoluene	0.2	**11.0	**3.8	**14.1	**2.1	**16.4	**9.5
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	2.1	1.0	2.4	0.5	2.5	1.7
1,2,4-Trimethylbenzene	0.2	4.7	3.3	5.1	1.5	6.7	4.3
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	6.6	2.8	2.6	2.1	3.0	3.4
1,2-Dichlorobenzene	0.5	1.2	0.4	0.3	0.2	2.8	1.0
1,3-Diethylbenzene	0.2	0.6	NA	0.5	0.1	0.7	0.4
1,4-Diethylbenzene	0.2	2.5	1.7	2.1	0.7	3.4	2.1
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	0.4	0.2	0.3	0.5	0.3
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F1 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	3.1	2.3	2.4	1.0	3.1	2.4
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F2: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, AERATION BASIN (INFLUENT)

Compounds	M.D.L.*	Concentration (ug/L)					
		Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	12.3	16.8	14.1	12.0	10.6	13.2
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.5	0.2	NA	NA	NA	0.1
Chloroform	0.5	0.6	1.1	1.5	1.2	1.4	1.2
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	0.5	0.1	0.3	NA	0.1	0.2
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.9	0.7	0.4	0.3	0.7	0.6
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	27.6	3.0	2.8	3.5	14.7	10.3
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.5	0.2	0.2	0.1	0.2	0.2
Ethylbenzene	0.5	0.2	NA	0.5	NA	0.3	0.2
m,p-xylene	0.5	0.5	0.1	2.2	0.2	1.2	0.8
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	0.5	0.1	2.5	0.3	2.1	1.1
Cumene	0.2	NA	NA	1.0	NA	0.8	0.4
Propylbenzene	0.2	0.2	0.1	1.8	0.2	1.5	0.8
3&4-Ethyltoluene	0.2	**0.7	**0.3	**9.4	**0.7	**7.1	**3.6
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	0.2	0.1	1.5	0.2	1.4	0.7
1,2,4-Trimethylbenzene	0.2	0.5	0.3	3.0	0.4	2.6	1.4
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.3	1.9	1.6	1.4	2.1	1.9
1,2-Dichlorobenzene	0.5	0.4	0.2	0.2	0.6	2.3	0.7
1,3-Diethylbenzene	0.2	NA	NA	0.1	NA	0.1	0.0
1,4-Diethylbenzene	0.2	0.1	0.2	0.5	0.1	0.7	0.3
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	0.2	0.0
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F2 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	0.4	0.2	1.0	0.3	1.2	0.6
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

** Merged with 1,3,5-Trimethylbenzene

TABLE F3: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, AERATION BASIN (MIDPOINT)

Compounds	M.D.L.*	Concentration (ug/L)					
		Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	4.9	13.2	12.5	10.8	5.2	9.3
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	0.2	NA	NA	NA	0.1
Chloroform	0.5	0.7	1.2	1.3	1.1	0.7	1.0
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	0.5	NA	0.2	NA	NA	0.1
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.5	0.3	0.2	0.1	0.3	0.3
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	4.1	3.5	3.1	3.4	3.6	3.5
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.5	0.2	0.1	0.1	0.2	0.2
Ethylbenzene	0.5	NA	NA	0.2	NA	NA	0.0
m,p-xylene	0.5	NA	NA	0.8	NA	0.3	0.2
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	0.8	NA	0.4	0.2
Cumene	0.2	NA	NA	0.6	NA	0.4	0.2
Propylbenzene	0.2	NA	NA	1.1	NA	0.7	0.4
3&4-Ethyltoluene	0.2	NA	NA	**3.7	NA	**1.8	**1.1
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	0.8	NA	0.5	0.3
1,2,4-Trimethylbenzene	0.2	NA	NA	1.2	NA	0.6	0.4
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.1	1.9	1.5	1.4	1.3	1.6
1,2-Dichlorobenzene	0.5	0.2	0.1	0.2	0.4	1.2	0.4
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	0.3	NA	0.4	0.1
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F3 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	0.6	NA	0.4	0.2
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

** Merged with 1,3,5-Trimethylbenzene

TABLE F4: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, AERATION BASIN (EFFLUENT)

Compounds	M.D.L.*	Concentration (ug/L) Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	3.4	13.0	12.0	11.4	5.0	9.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	1.3	NA	NA	NA	0.3
Chloroform	0.5	0.9	NA	0.8	1.2	0.6	0.7
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	0.5	NA	NA	NA	NA	0.1
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.3	0.1	NA	NA	0.2	0.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	3.6	2.5	5.4	2.9	5.8	4.0
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.5	0.2	0.1	0.1	0.2	0.2
Ethylbenzene	0.5	NA	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	0.1	NA	NA	0.0
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	0.1	NA	NA	0.0
Cumene	0.2	NA	NA	0.3	NA	0.2	0.1
Propylbenzene	0.2	NA	NA	0.5	NA	0.4	0.2
3&4-Ethyltoluene	0.2	NA	NA	**0.6	NA	**0.3	**0.2
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	0.2	NA	0.1	0.1
1,2,4-Trimethylbenzene	0.2	NA	NA	0.2	NA	0.1	0.1
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.9	1.9	1.4	1.4	1.5	1.6
1,2-Dichlorobenzene	0.5	0.2	NA	0.1	0.3	1.1	0.3
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	0.2	0.0
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F4 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	0.2	NA	0.1	0.1
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F5: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK, GRIT CHAMBER

Compounds	M.D.L.*	Concentration (ug/L) Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	21.1	19.4	6.9	18.2	24.3	18.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	1.3	0.8	1.2	0.3	0.8
Chloroform	0.5	5.8	7.2	2.7	6.2	3.5	5.1
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	51.8	137.0	149.0	133.0	14.2	97.0
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	0.5	0.4	0.3	NA	NA	0.2
Trichloroethylene	0.5	1.7	2.4	3.1	2.3	1010.0	203.9
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	14.2	22.1	4.6	23.2	3.4	13.5
Dibromochloromethane	2.0	0.2	0.2	0.2	NA	NA	0.1
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.3	2.6	0.8	1.5	2.6	2.0
Ethylbenzene	0.5	1.4	4.9	2.5	1.8	1.8	2.5
m,p-xylene	0.5	5.2	18.5	14.1	8.4	6.6	10.6
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	3.4	10.5	7.9	8.4	3.1	6.7
Cumene	0.2	0.8	1.7	0.2	3.3	0.8	1.4
Propylbenzene	0.2	2.1	5.2	0.7	8.5	2.9	3.9
3&4-Ethyltoluene	0.2	15.3	38.8	6.3	40.4	17.9	23.7
1,3,5-Trimethylbenzene	0.2	8.0	15.1	3.7	15.8	12.7	11.1
2-Ethyltoluene	0.2	3.8	8.0	2.2	7.3	6.8	5.6
1,2,4-Trimethylbenzene	0.2	20.7	35.6	10.2	21.1	23.1	22.1
1,3-Dichlorobenzene	0.5	0.1	NA	NA	NA	NA	0.0
1,4-Dichlorobenzene	0.5	3.7	4.8	3.9	5.5	4.8	4.5
1,2-Dichlorobenzene	0.5	1.0	1.8	0.2	1.0	1.8	1.2
1,3-Diethylbenzene	0.2	1.2	2.0	NA	0.8	1.3	1.1
1,4-Diethylbenzene	0.2	4.6	6.8	NA	3.0	5.4	4.0
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.3	2.5	0.2	0.3	69.0	14.5
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F5 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	1.3	6.2	0.2	1.7	1.3	2.1
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	10.4	13.5	3.9	4.6	10.3	8.5
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F6: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK, AERATION BASIN (INFLUENT)

Compounds	M.D.L.*	Concentration (ug/L)					
		Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	10.7	5.3	6.1	8.3	5.8	7.2
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	1.7	3.8	3.6	3.3	1.4	2.7
Chloroform	0.5	0.6	0.6	NA	NA	0.5	0.3
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	2.4	6.5	2.5	2.8	1.3	3.1
Benzene	0.5	0.2	0.2	0.2	0.2	0.3	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	0.1	NA	NA	0.0
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.3	0.3	0.9	0.2	102.8	20.9
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	3.8	17.5	15.7	9.0	5.8	10.4
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.3	0.3	0.3	0.3	0.4	0.3
Ethylbenzene	0.5	0.1	0.2	0.3	0.2	0.2	0.2
m,p-xylene	0.5	0.4	0.5	1.1	0.4	0.6	0.6
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	0.6	0.4	0.9	0.4	0.3	0.5
Cumene	0.2	0.2	0.1	0.1	0.1	NA	0.1
Propylbenzene	0.2	0.4	0.3	0.3	0.3	0.1	0.3
3&4-Ethyltoluene	0.2	**2.2	**2.8	**1.4	**1.5	**0.9	**1.8
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	0.4	0.6	0.5	0.6	0.2	0.5
1,2,4-Trimethylbenzene	0.2	1.4	2.2	1.0	1.0	0.7	1.3
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	NA	1.9	2.3	2.3	1.7	1.6
1,2-Dichlorobenzene	0.5	0.5	0.3	0.3	0.2	0.1	0.3
1,3-Diethylbenzene	0.2	NA	NA	NA	0.1	NA	0.0
1,4-Diethylbenzene	0.2	NA	0.3	NA	0.6	0.1	0.2
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	0.2	NA	NA	16.0	3.2
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F6 (cont.):

1-Bromo-2-Chloroethane	[illegible]	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	[illegible]	0.1	0.1	0.2	0.1	0.1	0.1
Styrene	[illegible]	NA	0.6	NA	0.1	NA	0.1
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	[illegible]	0.7	0.9	0.8	0.9	0.4	0.7
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	[illegible]	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F7: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK, AERATION BASIN (MIDPOINT)

Compounds	M.D.L.*	Concentration (ug/L)					
		Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	14.2	7.6	7.2	16.6	5.6	10.2
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	1.4	2.4	2.9	3.8	1.5	2.4
Chloroform	0.5	0.8	0.8	NA	0.7	0.4	0.5
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	1.8	3.0	1.7	2.9	1.1	2.1
Benzene	0.5	0.2	0.2	0.2	0.1	0.2	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.2	NA	0.9	NA	72.0	14.6
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	0.9	1.7	16.7	4.9	3.8	5.6
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.2	0.2	0.3	0.2	0.3	0.2
Ethylbenzene	0.5	NA	NA	0.3	0.1	0.2	0.1
m,p-xylene	0.5	0.2	0.2	0.9	0.2	0.3	0.4
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	0.3	0.2	0.7	0.3	0.2	0.3
Cumene	0.2	0.1	NA	0.1	0.1	NA	0.1
Propylbenzene	0.2	0.3	0.2	0.3	0.2	NA	0.2
3&4-Ethyltoluene	0.2	0.7	0.7	0.9	0.4	0.3	0.6
1,3,5-Trimethylbenzene	0.2	0.3	0.4	0.4	0.3	0.2	0.3
2-Ethyltoluene	0.2	0.2	0.3	0.5	0.4	0.1	0.3
1,2,4-Trimethylbenzene	0.2	0.5	0.7	0.9	0.4	0.4	0.6
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	NA	1.8	2.4	2.2	1.5	1.6
1,2-Dichlorobenzene	0.5	0.3	0.2	0.3	0.2	NA	0.2
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	0.2	NA	0.4	0.1	0.1
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	12.8	2.6
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F7 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F8: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK, AERATION BASIN (EFFLUENT)

Compounds	M.D.L.*	Concentration (ug/L) Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	12.1	7.0	12.3	10.7	5.3	9.5
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0,5	1.0	1.8	2.4	4.1	1.5	2.2
Chloroform	0.5	0.9	0.7	NA	NA	0.4	0.4
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	1.8	2.1	1.6	3.1	1.2	2.0
Benzene	0.5	NA	0.2	0.2	0.2	0.2	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	NA	0.1	0.7	NA	13.8	2.9
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	0.5	0.9	3.3	4.0	2.2	2.2
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.2	0.2	0.2	0.3	0.2	0.2
Ethylbenzene	0.5	NA	NA	0.2	0.1	NA	0.1
m,p-xylene	0.5	NA	NA	0.3	0.3	NA	0.1
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	0.4	0.3	NA	0.1
Cumene	0.2	NA	NA	0.1	0.1	NA	0.0
Propylbenzene	0.2	NA	0.1	0.2	0.2	NA	0.1
3&4-Ethyltoluene	0.2	NA	**0.3	**0.8	**0.8	NA	**0.4
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	0.1	0.4	0.4	NA	0.2
1,2,4-Trimethylbenzene	0.2	NA	0.2	0.4	0.5	NA	0.2
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.7	1.7	2.3	2.2	NA	1.6
1,2-Dichlorobenzene	0.5	0.4	0.1	0.3	0.2	NA	0.2
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	0.4	NA	0.1
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	0.4	0.1
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F8 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	0.1	0.2	0.2	NA	0.1	0.1
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	0.1	0.6	0.6	NA	0.3
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

** Merged with 1,3,5-Trimethylbenzene

TABLE F9: WASTEWATER CONCENTRATIONS - LAKEVIEW, GRIT CHAMBER

Compounds	M.D.L.*	Day 1	Day 2	Day 3	Day 4	Day 5	Average
		Concentration (ug/L)					
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	52.6	53.4	44.3	136.0	33.4	63.9
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.6	0.5	0.4	0.4	0.3	0.4
Chloroform	0.5	8.8	4.1	4.9	8.3	8.6	6.9
1,2-Dichloroethane	1.0	NA	0.6	6.8	NA	NA	1.5
1,1,1-Trichloroethane	0.5	31.0	8.1	5.1	23.9	4.5	14.5
Benzene	0.5	0.9	0.3	NA	0.6	0.7	0.5
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	0.2	NA	NA	0.0
Bromodichloroethane	1.0	1.0	0.2	0.5	0.4	0.2	0.5
Trichloroethylene	0.5	1.4	1.2	1.2	0.9	1.0	1.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	33.0	22.6	8.5	13.1	37.6	22.9
Dibromochloromethane	2.0	0.2	NA	NA	NA	NA	0.0
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	5.6	6.0	2.8	2.2	10.6	5.4
Ethylbenzene	0.5	1.8	2.2	1.6	3.8	6.7	3.2
m,p-xylene	0.5	8.7	10.7	6.8	15.5	30.6	14.4
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	4.9	6.3	3.2	11.9	16.4	8.5
Cumene	0.2	0.4	0.5	0.3	2.2	0.4	0.8
Propylbenzene	0.2	1.1	1.4	0.8	3.8	1.1	1.6
3&4-Ethyltoluene	0.2	8.6	14.2	5.3	28.3	9.4	13.2
1,3,5-Trimethylbenzene	0.2	4.2	5.0	2.5	11.1	5.0	5.6
2-Ethyltoluene	0.2	3.2	3.6	1.8	8.0	4.1	4.1
1,2,4-Trimethylbenzene	0.2	15.0	16.7	7.1	17.2	10.5	13.3
1,3-Dichlorobenzene	0.5	0.1	0.1	NA	NA	NA	0.0
1,4-Dichlorobenzene	0.5	3.7	4.5	2.5	3.0	2.9	3.3
1,2-Dichlorobenzene	0.5	1.6	1.0	0.1	1.4	0.4	0.9
1,3-Diethylbenzene	0.2	0.8	1.4	0.6	2.2	0.9	1.2
1,4-Diethylbenzene	0.2	3.3	6.1	2.5	7.1	3.8	4.6
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	0.5	NA	NA	NA	NA	0.1
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.6	0.3	0.5	0.5	0.4	0.5
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F9 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	0.2	NA	NA	NA	NA	0.0
Styrene	0.5	0.4	0.4	1.7	2.6	0.9	1.2
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	6.2	7.3	3.9	12.4	7.3	7.4
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F10: WASTEWATER CONCENTRATIONS - LAKEVIEW, AERATION BASIN (INFLUENT)

Compounds	M.D.L.*	Concentration (ug/L)					
		Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	42.8	102.0	69.6	117.0	89.9	84.3
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.5	0.8	0.3	1.3	0.5	0.7
Chloroform	0.5	1.4	1.3	1.6	3.8	2.4	2.1
1,2-Dichloroethane	1.0	NA	0.5	1.9	NA	0.7	0.6
1,1,1-Trichloroethane	0.5	2.1	1.4	0.7	2.7	2.6	1.9
Benzene	0.5	0.3	0.2	NA	0.3	0.3	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	0.2	0.1	0.1
Trichloroethylene	0.5	0.5	0.6	0.3	0.4	0.5	0.5
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	4.2	9.4	5.9	11.3	6.6	7.5
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.4	0.6	0.8	1.3	1.4	0.9
Ethylbenzene	0.5	0.2	1.1	0.3	0.7	2.3	0.9
m,p-xylene	0.5	1.2	4.8	1.5	2.9	8.8	3.8
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	1.0	2.4	1.1	1.7	4.4	2.1
Cumene	0.2	0.1	0.2	NA	0.1	0.1	0.1
Propylbenzene	0.2	0.4	0.5	0.1	0.3	0.3	0.3
3&4-Ethyltoluene	0.2	3.2	3.9	1.1	2.3	2.5	2.6
1,3,5-Trimethylbenzene	0.2	1.3	1.9	0.6	1.1	1.2	1.2
2-Ethyltoluene	0.2	1.1	1.6	0.5	1.0	1.2	1.1
1,2,4-Trimethylbenzene	0.2	4.7	6.6	1.7	3.8	3.9	4.1
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.0	1.9	1.3	1.3	1.3	1.4
1,2-Dichlorobenzene	0.5	0.2	0.4	0.1	1.3	0.6	0.5
1,3-Diethylbenzene	0.2	0.2	0.2	0.1	0.1	0.2	0.2
1,4-Diethylbenzene	0.2	0.7	1.1	0.4	0.4	0.5	0.6
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.1	0.2	0.2	0.2	0.2	0.2
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F10 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	0.6	0.3	0.4	1.6	0.6
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	2.4	3.3	1.3	2.2	2.2	2.3
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F11: WASTEWATER CONCENTRATIONS - LAKEVIEW, AERATION BASIN (MIDPOINT)

Compounds	M.D.L.*	Day 1	Day 2	Day 3	Day 4	Day 5	Average
		Concentration (ug/L)					
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	33.0	95.9	26.7	35.0	47.8	47.7
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.3	0.4	NA	0.2	NA	0.2
Chloroform	0.5	2.3	1.4	1.3	1.3	1.5	1.6
1,2-Dichloroethane	1.0	NA	0.8	1.8	NA	NA	0.5
1,1,1-Trichloroethane	0.5	1.7	0.6	0.1	0.4	0.5	0.7
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	0.1	NA	NA	NA	0.0
Trichloroethylene	0.5	0.9	0.2	NA	NA	NA	0.2
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	1.6	2.4	0.2	0.2	0.4	1.0
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.4	0.7	0.3	0.3	0.6	0.5
Ethylbenzene	0.5	0.3	0.3	NA	NA	0.1	0.1
m,p-xylene	0.5	1.4	0.7	NA	NA	NA	0.4
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	1.7	0.8	NA	NA	NA	0.5
Cumene	0.2	0.3	NA	NA	NA	NA	0.1
Propylbenzene	0.2	1.1	0.1	NA	NA	NA	0.2
3&4-Ethyltoluene	0.2	7.1	0.5	NA	NA	NA	1.5
1,3,5-Trimethylbenzene	0.2	4.6	0.3	NA	NA	NA	1.0
2-Ethyltoluene	0.2	2.8	0.3	NA	NA	NA	0.6
1,2,4-Trimethylbenzene	0.2	7.0	0.3	NA	NA	NA	1.5
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.3	1.5	0.9	0.9	0.7	1.1
1,2-Dichlorobenzene	0.5	0.3	0.4	NA	0.7	0.2	0.3
1,3-Diethylbenzene	0.2	0.5	NA	NA	NA	NA	0.1
1,4-Diethylbenzene	0.2	2.2	0.3	NA	NA	NA	0.5
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.2	0.1	NA	NA	NA	0.1
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F11 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	4.3	0.6	NA	NA	NA	1.0
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F12: WASTEWATER CONCENTRATIONS - LAKEVIEW, AERATION BASIN (EFFLUENT)

Compounds	M.D.L.*	Day 1	Day 2	Day 3	Day 4	Day 5	Average
		Concentration (ug/L)					
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	35.1	18.9	13.5	15.4	27.0	22.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.2	0.2	NA	NA	NA	0.1
Chloroform	0.5	1.4	1.2	1.2	1.1	1.3	1.2
1,2-Dichloroethane	1.0	NA	0.9	1.5	NA	NA	0.5
1,1,1-Trichloroethane	0.5	1.1	0.3	NA	NA	NA	0.3
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.2	0.1	NA	NA	0.8	0.2
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	0.8	0.3	0.2	0.1	0.1	0.3
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.4	0.5	0.1	0.1	0.2	0.3
Ethylbenzene	0.5	0.2	0.1	NA	NA	NA	0.1
m,p-xylene	0.5	0.4	0.1	NA	NA	NA	0.1
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	0.6	0.2	NA	NA	NA	0.2
Cumene	0.2	NA	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	0.3	NA	NA	NA	NA	0.1
1,3,5-Trimethylbenzene	0.2	0.2	NA	NA	NA	NA	0.0
2-Ethyltoluene	0.2	0.3	NA	NA	NA	NA	0.1
1,2,4-Trimethylbenzene	0.2	0.2	NA	NA	NA	NA	0.0
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	0.9	1.3	0.5	0.5	0.5	0.7
1,2-Dichlorobenzene	0.5	0.1	0.4	NA	0.2	NA	0.1
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	0.3	0.1	NA	NA	NA	0.1
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.1	NA	NA	NA	NA	0.0
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F12 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	0.6	NA	NA	NA	NA	0.1
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F13: WASTEWATER CONCENTRATIONS - WATERLOO, AERATION BASIN (INFLUENT)

Compounds	M.D.L.*	Concentration (ug/L) Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	4.8	5.8	9.0	5.7	1.3	5.3
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA	NA
Chloroform	0.5	0.7	0.9	2.1	1.3	0.6	1.1
1,2-Dichloroethane	1.0	NA	NA	0.1	NA	0.7	0.2
1,1,1-Trichloroethane	0.5	0.1	NA	NA	NA	NA	0.0
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	NA	0.1	0.4	0.2	NA	0.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	0.2	0.3	0.2	0.2	NA	0.2
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.3	0.2	1.6	0.5	0.3	0.6
Ethylbenzene	0.5	NA	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA	NA	NA	NA
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	NA	NA	NA	NA
Cumene	0.2	NA	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	0.1	NA	NA	0.0
1,3-Dichlorobenzene	0.5	0.1	NA	NA	NA	NA	0.0
1,4-Dichlorobenzene	0.5	1.5	1.3	1.2	1.2	1.3	1.3
1,2-Dichlorobenzene	0.5	0.6	0.1	0.1	0.1	NA	0.2
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F13 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	0.1	NA	NA	NA	0.0
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F14: WASTEWATER CONCENTRATIONS - WATERLOO, AERATION BASIN (MIDPOINT)

Compounds	M.D.L.*	Day 1	Day 2	Day 3	Day 4	Day 5	Average
		Concentration (ug/L)					
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	4.2	5.0	10.7	2.9	1.3	4.8
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA	NA
Chloroform	0.5	0.6	0.9	2.5	0.7	0.6	1.1
1,2-Dichloroethane	1.0	NA	0.1	NA	NA	NA	0.0
1,1,1-Trichloroethane	0.5	0.1	NA	NA	NA	NA	0.0
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	NA	NA	0.3	NA	NA	0.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	0.2	NA	0.1	0.1	NA	0.1
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.3	NA	1.5	0.4	NA	0.4
Ethylbenzene	0.5	NA	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA	NA	NA	NA
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	NA	NA	NA	NA
Cumene	0.2	NA	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.5	1.5	1.2	1.2	1.3	1.3
1,2-Dichlorobenzene	0.5	0.5	0.1	NA	NA	NA	0.1
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F14 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F15: WASTEWATER CONCENTRATIONS - WATERLOO, AERATION BASIN (EFFLUENT)

Compounds	M.D.L.*	Concentration (ug/L) Day 1	Day 2	Day 3	Day 4	Day 5	Average
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	3.2	4.7	7.6	3.2	2.8	4.3
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA	NA
Chloroform	0.5	0.4	NA	2.1	0.8	0.8	0.8
1,2-Dichloroethane	1.0	NA	NA	NA	NA	0.6	0.1
1,1,1-Trichloroethane	0.5	0.1	NA	NA	NA	NA	0.0
Benzene	0.5	NA	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	NA	NA	0.4	0.4	NA	0.2
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	NA	0.1	0.2	0.1	0.2	0.1
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	NA	0.1	1.7	0.3	0.3	0.5
Ethylbenzene	0.5	NA	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA	NA	NA	NA
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	NA	NA	NA	NA
Cumene	0.2	NA	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.3	1.3	1.2	1.1	1.2	1.2
1,2-Dichlorobenzene	0.5	0.4	0.1	NA	NA	NA	0.1
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE F15 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F16: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, DAY 1

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
		Concentration (ug/L)			
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	5.2	12.3	4.9	3.4
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.3	0.5	0.4	NA
Chloroform	0.5	3.3	0.6	0.7	0.9
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	2.2	0.5	0.5	0.5
Benzene	0.5	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	0.3	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA
Trichloroethylene	0.5	2.6	0.9	0.5	0.3
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	5.5	27.6	4.1	3.6
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	3.1	0.5	0.5	0.5
Ethylbenzene	0.5	0.3	0.2	NA	NA
m,p-xylene	0.5	2.0	0.5	NA	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	2.5	0.5	NA	NA
Cumene	0.2	0.5	NA	NA	NA
Propylbenzene	0.2	1.1	0.2	NA	NA
3&4-Ethyltoluene	0.2	7.7	**0.7	NA	NA
1,3,5-Trimethylbenzene	0.2	3.3	NA	NA	NA
2-Ethyltoluene	0.2	2.1	0.2	NA	NA
1,2,4-Trimethylbenzene	0.2	4.7	0.5	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	6.6	2.3	2.1	1.9
1,2-Dichlorobenzene	0.5	1.2	0.4	0.2	0.2
1,3-Diethylbenzene	0.2	0.6	NA	NA	NA
1,4-Diethylbenzene	0.2	2.5	0.1	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA

TABLE F16 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	3.1	0.4	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F17: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, DAY 2

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
			Concentration (ug/L)		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	15.7	16.8	13.2	13.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	0.2	0.2	1.3
Chloroform	0.5	4.9	1.1	1.2	NA
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	0.8	0.1	NA	NA
Benzene	0.5	0.3	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA
Trichloroethylene	0.5	2.3	0.7	0.3	0.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	2.8	3.0	3.5	2.5
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.8	0.2	0.2	0.2
Ethylbenzene	0.5	0.3	NA	NA	NA
m,p-xylene	0.5	2.2	0.1	NA	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	1.6	0.1	NA	NA
Cumene	0.2	NA	NA	NA	NA
Propylbenzene	0.2	0.2	0.1	NA	NA
3&4-Ethyltoluene	0.2	2.3	0.2	NA	NA
1,3,5-Trimethylbenzene	0.2	1.5	0.1	NA	NA
2-Ethyltoluene	0.2	1.0	0.1	NA	NA
1,2,4-Trimethylbenzene	0.2	3.3	0.3	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.8	1.9	1.9	1.9
1,2-Dichlorobenzene	0.5	0.4	0.2	0.1	NA
1,3-Diethylbenzene	0.2	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	1.7	0.2	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.4	NA	NA	NA

TABLE F17 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	2.3	0.2	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F18: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, DAY 3

Compounds	M.D.L.*	Concentration (ug/L) Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	10.2	14.1	12.5	12.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA
Chloroform	0.5	4.0	1.5	1.3	0.8
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	1.0	0.3	0.2	NA
Benzene	0.5	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	0.2	NA	NA	NA
Trichloroethylene	0.5	1.2	0.4	0.2	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	4.2	2.8	3.1	5.4
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	1.3	0.2	0.1	0.1
Ethylbenzene	0.5	0.4	0.5	0.2	NA
m,p-xylene	0.5	2.1	2.2	0.8	0.1
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	2.5	2.5	0.8	0.1
Cumene	0.2	0.8	1.0	0.6	0.3
Propylbenzene	0.2	1.9	1.8	1.1	0.5
3&4-Ethyltoluene	0.2	**14.1	**9.4	**3.7	**0.6
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA
2-Ethyltoluene	0.2	2.4	1.5	0.8	0.2
1,2,4-Trimethylbenzene	0.2	5.1	3.0	1.2	0.2
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.6	1.6	1.5	1.4
1,2-Dichlorobenzene	0.5	0.3	0.2	0.2	0.1
1,3-Diethylbenzene	0.2	0.5	0.1	NA	NA
1,4-Diethylbenzene	0.2	2.1	0.5	0.3	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.2	NA	NA	NA

TABLE F18 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	2.4	1.0	0.6	0.2
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

** Merged with 1,3,5-Trimethylbenzene

TABLE F19: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, DAY 4

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
		Concentration (ug/L)			
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	5.5	12.0	10.8	11.4
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA
Chloroform	0.5	2.9	1.2	1.1	1.2
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	0.6	NA	NA	NA
Benzene	0.5	0.2	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA
Trichloroethylene	0.5	0.8	0.3	0.1	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	2.4	3.5	3.4	2.9
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	1.1	0.1	0.1	0.1
Ethylbenzene	0.5	NA	NA	NA	NA
m,p-xylene	0.5	0.7	0.2	NA	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	0.7	0.3	NA	NA
Cumene	0.2	NA	NA	NA	NA
Propylbenzene	0.2	0.2	0.2	NA	NA
3&4-Ethyltoluene	0.2	1.4	**0.7	NA	NA
1,3,5-Trimethylbenzene	0.2	0.7	NA	NA	NA
2-Ethyltoluene	0.2	0.5	0.2	NA	NA
1,2,4-Trimethylbenzene	0.2	1.5	0.4	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.1	1.4	1.4	1.4
1,2-Dichlorobenzene	0.5	0.2	0.6	0.4	0.3
1,3-Diethylbenzene	0.2	0.1	NA	NA	NA
1,4-Diethylbenzene	0.2	0.7	0.1	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.3	NA	NA	NA

TABLE F19 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	1.0	0.3	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F20: WASTEWATER CONCENTRATIONS - BURLINGTON SKYWAY, DAY 5

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
		Concentration (ug/L)			
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	7.9	10.6	5.2	5.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA
Chloroform	0.5	4.0	1.4	0.7	0.6
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	0.5	0.1	NA	NA
Benzene	0.5	0.3	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA
Trichloroethylene	0.5	1.4	0.7	0.25	0.2
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	2.9	14.7	3.6	5.8
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	1.0	0.2	0.15	0.2
Ethylbenzene	0.5	0.3	0.3	NA	NA
m,p-xylene	0.5	1.8	1.2	0.25	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	2.3	2.1	0.35	NA
Cumene	0.2	1.0	0.8	0.35	0.2
Propylbenzene	0.2	2.3	1.5	0.7	0.4
3&4-Ethyltoluene	0.2	**16.4	**7.1	**1.8	0.2
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	0.1
2-Ethyltoluene	0.2	2.5	1.4	0.5	0.1
1,2,4-Trimethylbenzene	0.2	6.7	2.6	0.6	0.1
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	3.0	2.1	1.3	1.5
1,2-Dichlorobenzene	0.5	2.8	2.3	1.2	1.1
1,3-Diethylbenzene	0.2	0.7	0.1	NA	NA
1,4-Diethylbenzene	0.2	3.4	0.7	0.35	0.2
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.5	0.2	NA	NA

TABLE F20 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	3.1	1.2	0.4	0.1
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F21: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK WPCP, DAY 1

Compounds	M.D.L.*	Concentration (ug/L)			
		Grit Chamber	Aeration Basin		
			Influent	Midpoint	Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	21.1	10.7	14.2	12.1
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	1.7	1.4	1.0
Chloroform	0.5	5.8	0.6	0.8	0.9
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	51.8	2.4	1.8	1.8
Benzene	0.5	NA	0.2	0.2	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	0.5	NA	NA	NA
Trichloroethylene	0.5	1.7	0.3	0.2	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	14.2	3.8	0.9	0.5
Dibromochloromethane	2.0	0.2	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.3	0.3	0.2	0.2
Ethylbenzene	0.5	1.4	0.1	NA	NA
m,p-xylene	0.5	5.2	0.4	0.2	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	3.4	0.6	0.3	NA
Cumene	0.2	0.8	0.2	0.1	NA
Propylbenzene	0.2	2.1	0.4	0.3	NA
3&4-Ethyltoluene	0.2	15.3	**2.2	0.7	NA
1,3,5-Trimethylbenzene	0.2	8.0	NA	0.3	NA
2-Ethyltoluene	0.2	3.8	0.4	0.2	NA
1,2,4-Trimethylbenzene	0.2	20.7	1.4	0.5	NA
1,3-Dichlorobenzene	0.5	0.1	NA	NA	NA
1,4-Dichlorobenzene	0.5	3.7	NA	NA	1.7
1,2-Dichlorobenzene	0.5	1.0	0.5	0.3	0.4
1,3-Diethylbenzene	0.2	1.2	NA	NA	NA
1,4-Diethylbenzene	0.2	4.6	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.3	NA	NA	NA

Table F21 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	0.1	0.1	0.1
Styrene	0.5	1.3	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	10.4	0.7	0.3	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

** Merged with 1,3,5-Trimethylbenzene

TABLE F22: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK WPCP, DAY 2

Compounds	M.D.L.*	Concentration (ug/L) Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	19.4	5.3	7.6	7.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	1.3	3.8	2.4	1.8
Chloroform	0.5	7.2	0.6	0.8	0.7
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	137.0	6.5	3.0	2.1
Benzene	0.5	NA	0.2	0.2	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	0.4	NA	NA	NA
Trichloroethylene	0.5	2.4	0.3	NA	0.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	22.1	17.5	1.7	0.9
Dibromochloromethane	2.0	0.2	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.6	0.3	0.2	0.2
Ethylbenzene	0.5	4.9	0.2	NA	NA
m,p-xylene	0.5	18.5	0.5	0.2	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	10.5	0.4	0.2	NA
Cumene	0.2	1.7	0.1	NA	NA
Propylbenzene	0.2	5.2	0.3	0.2	0.1
3&4-Ethyltoluene	0.2	38.8	1.7	0.7	0.2
1,3,5-Trimethylbenzene	0.2	15.1	1.1	0.4	0.1
2-Ethyltoluene	0.2	8.0	0.6	0.3	0.1
1,2,4-Trimethylbenzene	0.2	35.6	2.2	0.7	0.2
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	4.8	1.9	1.8	1.7
1,2-Dichlorobenzene	0.5	1.8	0.3	0.2	0.1
1,3-Diethylbenzene	0.2	2.0	NA	NA	NA
1,4-Diethylbenzene	0.2	6.8	0.3	0.2	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	2.5	0.2	NA	NA

TABLE F22 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	0.1	0.1	0.2
Styrene	0.5	6.2	0.6	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	13.5	0.9	0.4	0.1
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F23: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK WPCP, DAY 3

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
			Concentration (ug/L)		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	6.9	6.1	7.2	12.3
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.8	3.6	2.9	2.4
Chloroform	0.5	2.7	NA	NA	NA
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	149.0	2.5	1.7	1.6
Benzene	0.5	NA	0.2	0.2	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	0.1	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	0.3	NA	NA	NA
Trichloroethylene	0.5	3.1	0.9	0.9	0.7
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	4.6	15.7	16.7	3.3
Dibromochloromethane	2.0	0.2	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.8	0.3	0.3	0.2
Ethylbenzene	0.5	2.5	0.3	0.3	0.2
m,p-xylene	0.5	14.1	1.1	0.9	0.3
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	7.9	0.9	0.7	0.4
Cumene	0.2	0.2	0.1	0.1	0.1
Propylbenzene	0.2	0.7	0.3	0.3	0.2
3&4-Ethyltoluene	0.2	6.3	0.9	0.9	**0.8
1,3,5-Trimethylbenzene	0.2	3.7	0.5	0.4	NA
2-Ethyltoluene	0.2	2.2	0.5	0.5	0.4
1,2,4-Trimethylbenzene	0.2	10.2	1.0	0.9	0.4
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	3.9	2.3	2.4	2.3
1,2-Dichlorobenzene	0.5	0.2	0.3	0.3	0.3
1,3-Diethylbenzene	0.2	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.2	NA	NA	NA

TABLE F23 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	0.2	0.1	0.2
Styrene	0.5	0.2	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	3.9	0.8	0.8	0.6
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F24: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK WPCP, DAY 4

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
		Concentration (ug/L)			
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	18.2	8.3	16.6	10.7
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	1.2	3.3	3.8	4.1
Chloroform	0.5	6.2	NA	0.7	NA
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	133.0	2.8	2.9	3.1
Benzene	0.5	NA	0.2	0.1	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA
Trichloroethylene	0.5	2.3	0.2	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	23.2	9.0	4.9	4.0
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	1.5	0.3	0.2	0.3
Ethylbenzene	0.5	1.8	0.2	0.1	0.1
m,p-xylene	0.5	8.4	0.4	0.2	0.3
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	8.4	0.4	0.3	0.3
Cumene	0.2	3.3	0.1	0.1	0.1
Propylbenzene	0.2	8.5	0.3	0.2	0.2
3&4-Ethyltoluene	0.2	40.4	0.9	0.4	0.5
1,3,5-Trimethylbenzene	0.2	15.8	0.6	0.3	0.3
2-Ethyltoluene	0.2	7.3	0.6	0.4	0.4
1,2,4-Trimethylbenzene	0.2	21.1	1.0	0.4	0.5
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	5.5	2.3	2.2	2.2
1,2-Dichlorobenzene	0.5	1.0	0.2	0.2	0.2
1,3-Diethylbenzene	0.2	0.8	0.1	NA	NA
1,4-Diethylbenzene	0.2	3.0	0.6	0.4	0.4
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.3	NA	NA	NA

TABLE F24 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	0.1	0.1	NA
Styrene	0.5	1.7	0.1	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	4.6	0.9	0.6	0.6
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F25: WASTEWATER CONCENTRATIONS - HIGHLAND CREEK WPCP, DAY 5

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
		Concentration (ug/L)			
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	24.3	5.8	5.6	5.3
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.3	1.4	1.5	1.5
Chloroform	0.5	3.5	0.5	0.4	0.4
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	14.2	1.3	1.1	1.2
Benzene	0.5	NA	0.3	0.2	0.2
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA
Trichloroethylene	0.5	1010.0	102.8	72.0	13.8
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	3.4	5.8	3.8	2.2
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.6	0.4	0.3	0.2
Ethylbenzene	0.5	1.8	0.2	0.2	NA
m,p-xylene	0.5	6.6	0.6	0.3	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	3.1	0.3	0.2	NA
Cumene	0.2	0.8	NA	NA	NA
Propylbenzene	0.2	2.9	0.1	NA	NA
3&4-Ethyltoluene	0.2	17.9	**0.9	0.3	NA
1,3,5-Trimethylbenzene	0.2	12.7	NA	0.2	NA
2-Ethyltoluene	0.2	6.8	0.2	0.1	NA
1,2,4-Trimethylbenzene	0.2	23.1	0.7	0.4	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	4.8	1.7	1.5	NA
1,2-Dichlorobenzene	0.5	1.8	0.1	NA	NA
1,3-Diethylbenzene	0.2	1.3	NA	NA	NA
1,4-Diethylbenzene	0.2	5.4	0.1	0.1	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	69.0	16.0	12.8	0.4

TABLE F25 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	0.1	0.1	0.1
Styrene	0.5	1.3	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	10.3	0.4	0.2	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene

TABLE F26: WASTEWATER CONCENTRATIONS - LAKEVIEW WPCP, DAY 1

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
	Concentration (ug/L)				
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	52.6	42.8	33.0	35.1
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.6	0.5	0.3	0.2
Chloroform	0.5	8.8	1.4	2.3	1.4
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	31.0	2.1	1.7	1.1
Benzene	0.5	0.9	0.3	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	1.0	NA	NA	NA
Trichloroethylene	0.5	1.4	0.5	0.9	0.2
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	33.0	4.2	1.6	0.8
Dibromochloromethane	2.0	0.2	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	5.6	0.4	0.4	0.4
Ethylbenzene	0.5	1.8	0.2	0.3	0.2
m,p-xylene	0.5	8.7	1.2	1.4	0.4
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	4.9	1.0	1.7	0.6
Cumene	0.2	0.4	0.1	0.3	NA
Propylbenzene	0.2	1.1	0.4	1.1	NA
3&4-Ethyltoluene	0.2	8.6	3.2	7.1	0.3
1,3,5-Trimethylbenzene	0.2	4.2	1.3	4.6	0.2
2-Ethyltoluene	0.2	3.2	1.1	2.8	0.3
1,2,4-Trimethylbenzene	0.2	15.0	4.7	7.0	0.2
1,3-Dichlorobenzene	0.5	0.1	NA	NA	NA
1,4-Dichlorobenzene	0.5	3.7	1.0	1.3	0.9
1,2-Dichlorobenzene	0.5	1.6	0.2	0.3	0.1
1,3-Diethylbenzene	0.2	0.8	0.2	0.5	NA
1,4-Diethylbenzene	0.2	3.3	0.7	2.2	0.3
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	0.5	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.6	0.1	0.2	0.1

TABLE F26 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	0.2	NA	NA	NA
Styrene	0.5	0.4	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	6.2	2.4	4.3	0.6
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F27: WASTEWATER CONCENTRATIONS - LAKEVIEW WPCP, DAY 2

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
		Concentration (ug/L)			
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	53.4	102.0	95.9	18.9
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.5	0.8	0.4	0.2
Chloroform	0.5	4.1	1.3	1.4	1.2
1,2-Dichloroethane	1.0	0.6	0.5	0.8	0.9
1,1,1-Trichloroethane	0.5	8.1	1.4	0.6	0.3
Benzene	0.5	0.3	0.2	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	0.2	NA	0.1	NA
Trichloroethylene	0.5	1.2	0.6	0.2	0.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	22.6	9.4	2.4	0.3
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	6.0	0.6	0.7	0.5
Ethylbenzene	0.5	2.2	1.1	0.3	0.1
m,p-xylene	0.5	10.7	4.8	0.7	0.1
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	6.3	2.4	0.8	0.2
Cumene	0.2	0.5	0.2	NA	NA
Propylbenzene	0.2	1.4	0.5	0.1	NA
3&4-Ethyltoluene	0.2	14.2	3.9	0.5	NA
1,3,5-Trimethylbenzene	0.2	5.0	1.9	0.3	NA
2-Ethyltoluene	0.2	3.6	1.6	0.3	NA
1,2,4-Trimethylbenzene	0.2	16.7	6.6	0.3	NA
1,3-Dichlorobenzene	0.5	0.1	NA	NA	NA
1,4-Dichlorobenzene	0.5	4.5	1.9	1.5	1.3
1,2-Dichlorobenzene	0.5	1.0	0.4	0.4	0.4
1,3-Diethylbenzene	0.2	1.4	0.2	NA	NA
1,4-Diethylbenzene	0.2	6.1	1.1	0.3	0.1
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.3	0.2	0.1	NA

TABLE F27 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	0.4	0.6	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	7.3	3.3	0.6	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F28: WASTEWATER CONCENTRATIONS - LAKEVIEW WPCP, DAY 3

Compounds	M.D.L.*	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
		Concentration (ug/L)			
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	44.3	69.6	26.7	13.5
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	0.3	NA	NA
Chloroform	0.5	4.9	1.6	1.3	1.2
1,2-Dichloroethane	1.0	6.8	1.9	1.8	1.5
1,1,1-Trichloroethane	0.5	5.1	0.7	0.1	NA
Benzene	0.5	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	0.2	NA	NA	NA
Bromodichloroethane	1.0	0.5	NA	NA	NA
Trichloroethylene	0.5	1.2	0.3	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	8.5	5.9	0.2	0.2
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.8	0.8	0.3	0.1
Ethylbenzene	0.5	1.6	0.3	NA	NA
m,p-xylene	0.5	6.8	1.5	NA	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	3.2	1.1	NA	NA
Cumene	0.2	0.3	NA	NA	NA
Propylbenzene	0.2	0.8	0.1	NA	NA
3&4-Ethyltoluene	0.2	5.3	1.1	NA	NA
1,3,5-Trimethylbenzene	0.2	2.5	0.6	NA	NA
2-Ethyltoluene	0.2	1.8	0.5	NA	NA
1,2,4-Trimethylbenzene	0.2	7.1	1.7	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.5	1.3	0.9	0.5
1,2-Dichlorobenzene	0.5	0.1	0.1	NA	NA
1,3-Diethylbenzene	0.2	0.6	0.1	NA	NA
1,4-Diethylbenzene	0.2	2.5	0.4	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.5	0.2	NA	NA

TABLE F28 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	1.7	0.3	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	3.9	1.3	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F29: WASTEWATER CONCENTRATIONS - LAKEVIEW WPCP, DAY 4

Compounds	M.D.L.*	Concentration (ug/L) Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	136.0	117.0	35.0	15.4
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	1.3	0.2	NA
Chloroform	0.5	8.3	3.8	1.3	1.1
1,2-Dichloroethane	1.0	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	23.9	2.7	0.4	NA
Benzene	0.5	0.6	0.3	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	0.4	0.2	NA	NA
Trichloroethylene	0.5	0.9	0.4	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	13.1	11.3	0.2	0.1
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.2	1.3	0.3	0.1
Ethylbenzene	0.5	3.8	0.7	NA	NA
m,p-xylene	0.5	15.5	2.9	NA	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	11.9	1.7	NA	NA
Cumene	0.2	2.2	0.1	NA	NA
Propylbenzene	0.2	3.8	0.3	NA	NA
3&4-Ethyltoluene	0.2	28.3	2.3	NA	NA
1,3,5-Trimethylbenzene	0.2	11.1	1.1	NA	NA
2-Ethyltoluene	0.2	8.0	1.0	NA	NA
1,2,4-Trimethylbenzene	0.2	17.2	3.8	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	3.0	1.3	0.9	0.5
1,2-Dichlorobenzene	0.5	1.4	1.3	0.7	0.2
1,3-Diethylbenzene	0.2	2.2	0.1	NA	NA
1,4-Diethylbenzene	0.2	7.1	0.4	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.5	0.2	NA	NA

TABLE F29 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	2.6	0.4	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	12.4	2.2	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F30: WASTEWATER CONCENTRATIONS - LAKEVIEW WPCP, DAY 5

Compounds	M.D.L.*	Concentration (ug/L) Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA	NA
Dichloromethane	1.0	33.4	89.9	47.8	27.0
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.3	0.5	NA	NA
Chloroform	0.5	8.6	2.4	1.5	1.3
1,2-Dichloroethane	1.0	NA	0.7	NA	NA
1,1,1-Trichloroethane	0.5	4.5	2.6	0.5	NA
Benzene	0.5	0.7	0.3	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA
Bromodichloroethane	1.0	0.2	0.1	NA	NA
Trichloroethylene	0.5	1.0	0.5	NA	0.8
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA
Toluene	0.5	37.6	6.6	0.4	0.1
Dibromochloromethane	2.0	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA
Tetrachloroethylene	0.5	10.6	1.4	0.6	0.2
Ethylbenzene	0.5	6.7	2.3	0.1	NA
m,p-xylene	0.5	30.6	8.8	NA	NA
Bromoform	2.0	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA
o-xylene	0.5	16.4	4.4	NA	NA
Cumene	0.2	0.4	0.1	NA	NA
Propylbenzene	0.2	1.1	0.3	NA	NA
3&4-Ethyltoluene	0.2	9.4	2.5	NA	NA
1,3,5-Trimethylbenzene	0.2	5.0	1.2	NA	NA
2-Ethyltoluene	0.2	4.1	1.2	NA	NA
1,2,4-Trimethylbenzene	0.2	10.5	3.9	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.9	1.3	0.7	0.5
1,2-Dichlorobenzene	0.5	0.4	0.6	0.2	NA
1,3-Diethylbenzene	0.2	0.9	0.2	NA	NA
1,4-Diethylbenzene	0.2	3.8	0.5	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.4	0.2	NA	NA

TABLE F30 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA
Styrene	0.5	0.9	1.6	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	7.3	2.2	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F31: WASTEWATER CONCENTRATIONS - WATERLOO WPCP, DAY 1

Compounds	M.D.L.*	Concentration (ug/L) Aeration Basin Influent	Midpoint	Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA
Dichloromethane	1.0	4.8	4.2	3.2
trans-1,2-Dichloroethylene	0.5	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA
Chloroform	0.5	0.7	0.6	0.4
1,2-Dichloroethane	1.0	NA	NA	NA
1,1,1-Trichloroethane	0.5	0.1	0.1	0.1
Benzene	0.5	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA
Trichloroethylene	0.5	NA	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA
Toluene	0.5	0.2	0.2	NA
Dibromochloromethane	2.0	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA
Tetrachloroethylene	0.5	0.3	0.3	NA
Ethylbenzene	0.5	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA
Bromoform	2.0	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA
o-xylene	0.5	NA	NA	NA
Cumene	0.2	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA
1,3-Dichlorobenzene	0.5	0.1	NA	NA
1,4-Dichlorobenzene	0.5	1.5	1.5	1.3
1,2-Dichlorobenzene	0.5	0.6	0.5	0.4
1,3-Diethylbenzene	0.2	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA
Chloromethane	5.0	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA
Chloroethane	5.0	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA
Bromomethane	2.0	NA	NA	NA
Acrolein	25.0	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA

TABLE F31 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA
Styrene	0.5	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F32: WASTEWATER CONCENTRATIONS - WATERLOO WPCP, DAY 2

Compounds	M.D.L.*	Concentration (ug/L) Aeration Basin Influent	Midpoint	Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA
Dichloromethane	1.0	5.8	5.0	4.7
trans-1,2-Dichloroethylene	0.5	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA
Chloroform	0.5	0.9	0.9	NA
1,2-Dichloroethane	1.0	NA	0.1	NA
1,1,1-Trichloroethane	0.5	NA	NA	NA
Benzene	0.5	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA
Trichloroethylene	0.5	0.1	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA
Toluene	0.5	0.3	NA	0.1
Dibromochloromethane	2.0	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA
Tetrachloroethylene	0.5	0.2	NA	0.1
Ethylbenzene	0.5	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA
Bromoform	2.0	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA
o-xylene	0.5	NA	NA	NA
Cumene	0.2	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.3	1.5	1.3
1,2-Dichlorobenzene	0.5	0.1	0.1	0.1
1,3-Diethylbenzene	0.2	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA
Chloromethane	5.0	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA
Chloroethane	5.0	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA
Bromomethane	2.0	NA	NA	NA
Acrolein	25.0	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA

TABLE F32 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA
Styrene	0.5	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	0.1	NA	NA
Hexachloroethane	1.0	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F33: WASTEWATER CONCENTRATIONS - WATERLOO WPCP, DAY 3

Compounds	M.D.L.*	Concentration (ug/L) Aeration Basin Influent	Midpoint	Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA
Dichloromethane	1.0	9.0	10.7	7.6
trans-1,2-Dichloroethylene	0.5	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA
Chloroform	0.5	2.1	2.5	2.1
1,2-Dichloroethane	1.0	0.1	NA	NA
1,1,1-Trichloroethane	0.5	NA	NA	NA
Benzene	0.5	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA
Trichloroethylene	0.5	0.4	0.3	0.4
1,1,2-Trichloroethane	2.0	NA	NA	NA
Toluene	0.5	0.2	0.1	0.2
Dibromochloromethane	2.0	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA
Tetrachloroethylene	0.5	1.6	1.5	1.7
Ethylbenzene	0.5	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA
Bromoform	2.0	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA
o-xylene	0.5	NA	NA	NA
Cumene	0.2	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	0.1	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.2	1.2	1.2
1,2-Dichlorobenzene	0.5	0.1	NA	NA
1,3-Diethylbenzene	0.2	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA
Chloromethane	5.0	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA
Chloroethane	5.0	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA
Bromomethane	2.0	NA	NA	NA
Acrolein	25.0	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA

TABLE F33 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA
Styrene	0.5	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F34: WASTEWATER CONCENTRATIONS - WATERLOO WPCP, DAY 4

Compounds	M.D.L.*	Concentration (ug/L) Aeration Basin Influent	Midpoint	Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA
Dichloromethane	1.0	5.7	2.9	3.2
trans-1,2-Dichloroethylene	0.5	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA
Chloroform	0.5	1.3	0.7	0.8
1,2-Dichloroethane	1.0	NA	NA	NA
1,1,1-Trichloroethane	0.5	NA	NA	NA
Benzene	0.5	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA
Trichloroethylene	0.5	0.2	NA	0.4
1,1,2-Trichloroethane	2.0	NA	NA	NA
Toluene	0.5	0.2	0.1	0.1
Dibromochloromethane	2.0	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA
Tetrachloroethylene	0.5	0.5	0.4	0.3
Ethylbenzene	0.5	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA
Bromoform	2.0	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA
o-xylene	0.5	NA	NA	NA
Cumene	0.2	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.2	1.2	1.1
1,2-Dichlorobenzene	0.5	0.1	NA	NA
1,3-Diethylbenzene	0.2	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA
Chloromethane	5.0	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA
Chloroethane	5.0	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA
Bromomethane	2.0	NA	NA	NA
Acrolein	25.0	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA

TABLE F34 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA
Styrene	0.5	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE F35: WASTEWATER CONCENTRATIONS - WATERLOO WPCP, DAY 5

Compounds	M.D.L.*	Concentration (ug/L) Aeration Basin Influent	Midpoint	Effluent
1,1-Dichloroethylene	1.0	NA	NA	NA
Dichloromethane	1.0	1.3	1.3	2.8
trans-1,2-Dichloroethylene	0.5	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA
Chloroform	0.5	0.6	0.6	0.8
1,2-Dichloroethane	1.0	0.7	NA	0.6
1,1,1-Trichloroethane	0.5	NA	NA	NA
Benzene	0.5	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA
Trichloroethylene	0.5	NA	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA
Toluene	0.5	NA	NA	0.2
Dibromochloromethane	2.0	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA
Tetrachloroethylene	0.5	0.3	NA	0.3
Ethylbenzene	0.5	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA
Bromoform	2.0	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA
o-xylene	0.5	NA	NA	NA
Cumene	0.2	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.3	1.3	1.2
1,2-Dichlorobenzene	0.5	NA	NA	NA
1,3-Diethylbenzene	0.2	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA
Chloromethane	5.0	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA
Chloroethane	5.0	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA
Bromomethane	2.0	NA	NA	NA
Acrolein	25.0	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA

TABLE F35 (cont.):

Dichloroacetonitrile	15.0	NA	NA	NA
1-Bromo-2-Chloroethane	2.0	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA
Styrene	0.5	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA

* M.D.L. = minimum detection limit

APPENDIX G

Wastewater Quality Assurance Data

TABLE G1: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - SKYWAY

Compounds	GRIT CHAMBER					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean***		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	6.6	13.8	10.2	5.1	49.9
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA
Chloroform	0.5	4.0	3.9	4.0	0.1	1.8
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	1.1	0.9	1.0	0.1	14.1
Benzene	0.5	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	0.4	NA	0.2	0.3	141.4
Trichloroethylene	0.5	1.4	0.9	1.2	0.4	30.7
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	5.6	2.8	4.2	2.0	47.1
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	1.7	0.9	1.3	0.6	43.5
Ethylbenzene	0.5	0.4	0.3	0.4	0.1	20.2
m,p-xylene	0.5	2.3	1.8	2.1	0.4	17.2
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	2.7	2.2	2.5	0.4	14.4
Cumene	0.2	0.9	0.7	0.8	0.1	17.7
Propylbenzene	0.2	2.1	1.6	1.9	0.4	19.1
3&4-Ethyltoluene	0.2	**15.7	**12.5	**14.1	2.3	16.0
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	2.6	2.1	2.4	0.4	15.0
1,2,4-Trimethylbenzene	0.2	5.6	4.6	5.1	0.7	13.9
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.7	2.4	2.6	0.2	8.3
1,2-Dichlorobenzene	0.5	0.3	0.3	0.3	0.0	0.0
1,3-Diethylbenzene	0.2	0.5	0.4	0.5	0.1	15.7
1,4-Diethylbenzene	0.2	2.3	1.9	2.1	0.3	13.5
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.2	0.2	0.2	0.0	0.0
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G1 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	2.5	2.2	2.4	0.2	9.0
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

*   M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene
*** Day 3

TABLE G2: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - SKYWAY

Compounds	Aeration Basin - Midpoint					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation	Coeff. of Variation
	M.D.L.*	Duplicates		Mean***	(ug/L)	(%)
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	5.3	5.1	5.2	0.1	2.7
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA
Chloroform	0.5	0.7	0.7	0.7	0.0	0.0
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	NA	NA	NA	NA	NA
Benzene	0.5	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.3	0.2	0.3	0.1	28.3
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	3.9	3.3	3.6	0.4	11.8
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.2	0.1	0.2	0.1	47.1
Ethylbenzene	0.5	NA	NA	NA	NA	NA
m,p-xylene	0.5	0.3	0.2	0.3	0.1	28.3
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	0.4	0.3	0.4	0.1	20.2
Cumene	0.2	0.4	0.3	0.4	0.1	20.2
Propylbenzene	0.2	0.7	0.7	0.7	0.0	0.0
3&4-Ethyltoluene	0.2	**1.8	**1.8	**1.8	0.0	0.0
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	0.5	0.5	0.5	0.0	0.0
1,2,4-Trimethylbenzene	0.2	0.6	0.6	0.6	0.0	0.0
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.3	1.3	1.3	0.0	0.0
1,2-Dichlorobenzene	0.5	1.2	1.2	1.2	0.0	0.0
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	0.3	0.4	0.4	0.1	20.2
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G2 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	0.4	0.4	0.4	0.0	0.0
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Merged with 1,3,5-Trimethylbenzene
*** Day 5

TABLE G3: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - HIGHLAND CREEK

Compounds	Aeration Basin - Influent					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean***		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	5.9	6.2	6.1	0.2	3.5
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	3.4	3.7	3.6	0.2	6.0
Chloroform	0.5	NA	NA	NA	NA	NA
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	2.3	2.7	2.5	0.3	11.3
Benzene	0.5	0.2	0.2	0.2	0.0	0.0
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	0.1	0.1	0.1	141.4
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.8	0.9	0.9	0.1	8.3
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	12.9	18.4	15.7	3.9	24.9
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.2	0.3	0.3	0.1	28.3
Ethylbenzene	0.5	0.3	0.3	0.3	0.0	0.0
m,p-xylene	0.5	1.0	1.1	1.1	0.1	6.7
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	0.8	0.9	0.9	0.1	8.3
Cumene	0.2	0.1	0.1	0.1	0.0	0.0
Propylbenzene	0.2	0.3	0.3	0.3	0.0	0.0
3&4-Ethyltoluene	0.2	**1.2	**1.5	**1.4	0.2	15.2
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	0.5	0.5	0.5	0.0	0.0
1,2,4-Trimethylbenzene	0.2	0.9	1.1	1.0	0.1	14.1
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.2	2.3	2.3	0.1	3.1
1,2-Dichlorobenzene	0.5	0.3	0.3	0.3	0.0	0.0
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G3 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	0.2	0.1	0.2	0.1	47.1
Styrene	0.5	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	0.7	0.8	0.8	0.1	9.4
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

** Merged with 1,3,5-Trimethylbenzene

*** Day 3

TABLE G4: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - HIGHLAND CREEK

Compounds	Aeration Basin - Influent					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean***		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	5.7	5.8	5.8	0.1	1.2
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	1.4	1.3	1.4	0.1	5.2
Chloroform	0.5	0.5	0.4	0.5	0.1	15.7
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	1.5	1.1	1.3	0.3	21.8
Benzene	0.5	0.2	0.3	0.3	0.1	28.3
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA
Trichloroethylene	0.5	122.0	83.5	102.8	27.2	26.5
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	5.4	6.2	5.8	0.6	9.8
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.4	0.3	0.4	0.1	20.2
Ethylbenzene	0.5	0.2	0.2	0.2	0.0	0.0
m,p-xylene	0.5	0.6	0.6	0.6	0.0	0.0
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	0.3	0.3	0.3	0.0	0.0
Cumene	0.2	NA	NA	NA	NA	NA
Propylbenzene	0.2	0.1	0.1	0.1	0.0	0.0
3&4-Ethyltoluene	0.2	**0.8	**0.9	**0.9	0.1	7.9
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	0.2	0.2	0.2	0.0	0.0
1,2,4-Trimethylbenzene	0.2	0.7	0.7	0.7	0.0	0.0
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.7	1.7	1.7	0.0	0.0
1,2-Dichlorobenzene	0.5	0.1	0.1	0.1	0.0	0.0
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	0.1	0.1	0.1	0.0	0.0
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	3.4	28.5	16.0	17.7	111.3
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G4 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	0.1	0.1	0.1	0.0	0.0
Styrene	0.5	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	0.4	0.4	0.4	0.0	0.0
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

** Merged with 1,3,5-Trimethylbenzene

*** Day 5

TABLE G5: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - LAKEVIEW

Compounds	Grit Chamber					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean**		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	47.7	57.5	52.6	6.9	13.2
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	0.7	0.6	0.2	38.6
Chloroform	0.5	7.5	10.1	8.8	1.8	20.9
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	30.9	31.1	31.0	0.1	0.5
Benzene	0.5	0.8	1.0	0.9	0.1	15.7
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	1.2	0.7	1.0	0.4	37.2
Trichloroethylene	0.5	1.3	1.5	1.4	0.1	10.1
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	30.2	35.7	33.0	3.9	11.8
Dibromochloromethane	2.0	0.4	NA	0.2	0.3	141.4
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	5.3	5.9	5.6	0.4	7.6
Ethylbenzene	0.5	1.7	1.8	1.8	0.1	4.0
m,p-xylene	0.5	8.7	8.6	8.7	0.1	0.8
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	4.7	5.0	4.9	0.2	4.4
Cumene	0.2	0.4	0.4	0.4	0.0	0.0
Propylbenzene	0.2	1.1	1.0	1.1	0.1	6.7
3&4-Ethyltoluene	0.2	9.5	7.7	8.6	1.3	14.8
1,3,5-Trimethylbenzene	0.2	3.9	4.5	4.2	0.4	10.1
2-Ethyltoluene	0.2	3.1	3.3	3.2	0.1	4.4
1,2,4-Trimethylbenzene	0.2	15.1	14.8	15.0	0.2	1.4
1,3-Dichlorobenzene	0.5	0.1	0.1	0.1	0.0	0.0
1,4-Dichlorobenzene	0.5	3.5	3.9	3.7	0.3	7.6
1,2-Dichlorobenzene	0.5	1.5	1.7	1.6	0.1	8.8
1,3-Diethylbenzene	0.2	0.8	0.8	0.8	0.0	0.0
1,4-Diethylbenzene	0.2	3.3	3.2	3.3	0.1	2.2
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	1.0	NA	0.5	0.7	141.4
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.6	0.6	0.6	0.0	0.0
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G5 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	0.2	0.2	0.2	0.0	0.0
Styrene	0.5	0.4	0.4	0.4	0.0	0.0
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	5.9	6.5	6.2	0.4	6.8
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

*   M.D.L. = minimum detection limit
** Day 1

TABLE G6: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - LAKEVIEW

Compounds	Grit Chamber					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean**		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	45.9	42.7	44.3	2.3	5.1
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	0.3	0.4	0.1	20.2
Chloroform	0.5	5.0	4.7	4.9	0.2	4.4
1,2-Dichloroethane	1.0	6.7	6.8	6.8	0.1	1.0
1,1,1-Trichloroethane	0.5	5.2	4.9	5.1	0.2	4.2
Benzene	0.5	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	0.2	0.2	0.2	0.0	0.0
Bromodichloroethane	1.0	0.5	0.5	0.5	0.0	0.0
Trichloroethylene	0.5	1.2	1.2	1.2	0.0	0.0
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	8.8	8.1	8.5	0.5	5.9
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.8	2.8	2.8	0.0	0.0
Ethylbenzene	0.5	1.7	1.4	1.6	0.2	13.7
m,p-xylene	0.5	7.5	6.0	6.8	1.1	15.7
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	3.5	2.8	3.2	0.5	15.7
Cumene	0.2	0.3	0.2	0.3	0.1	28.3
Propylbenzene	0.2	0.8	0.8	0.8	0.0	0.0
3&4-Ethyltoluene	0.2	5.5	5.0	5.3	0.4	6.7
1,3,5-Trimethylbenzene	0.2	2.7	2.3	2.5	0.3	11.3
2-Ethyltoluene	0.2	1.9	1.7	1.8	0.1	7.9
1,2,4-Trimethylbenzene	0.2	7.5	6.7	7.1	0.6	8.0
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	2.7	2.2	2.5	0.4	14.4
1,2-Dichlorobenzene	0.5	0.1	0.1	0.1	0.0	0.0
1,3-Diethylbenzene	0.2	0.6	0.6	0.6	0.0	0.0
1,4-Diethylbenzene	0.2	2.5	2.5	2.5	0.0	0.0
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.0	0.0
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G6 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	1.9	1.5	1.7	0.3	16.6
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	4.2	3.6	3.9	0.4	10.9
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Day 3

TABLE G7: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - LAKEVIEW

Compounds	Grit Chamber					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean**		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	136.0	158.0	147.0	15.6	10.6
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	0.4	0.3	0.4	0.1	20.2
Chloroform	0.5	8.3	11.9	10.1	2.5	25.2
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	23.9	30.3	27.1	4.5	16.7
Benzene	0.5	0.6	3.1	1.9	1.8	95.6
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	0.1	0.1	0.1	141.4
Bromodichloroethane	1.0	0.4	0.8	0.6	0.3	47.1
Trichloroethylene	0.5	0.9	1.2	1.1	0.2	20.2
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	13.1	15.6	14.4	1.8	12.3
Dibromochloromethane	2.0	NA	0.2	0.1	0.1	141.4
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	2.2	2.5	2.4	0.2	9.0
Ethylbenzene	0.5	3.8	3.6	3.7	0.1	3.8
m,p-xylene	0.5	15.5	14.8	15.2	0.5	3.3
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	11.9	11.6	11.8	0.2	1.8
Cumene	0.2	2.2	2.0	2.1	0.1	6.7
Propylbenzene	0.2	3.8	3.5	3.7	0.2	5.8
3&4-Ethyltoluene	0.2	28.3	29.3	28.8	0.7	2.5
1,3,5-Trimethylbenzene	0.2	11.1	11.9	11.5	0.6	4.9
2-Ethyltoluene	0.2	8.0	7.6	7.8	0.3	3.6
1,2,4-Trimethylbenzene	0.2	17.2	19.3	18.3	1.5	8.1
1,3-Dichlorobenzene	0.5	NA	0.1	0.1	0.1	141.4
1,4-Dichlorobenzene	0.5	3.0	3.2	3.1	0.1	4.6
1,2-Dichlorobenzene	0.5	1.4	1.5	1.5	0.1	4.9
1,3-Diethylbenzene	0.2	2.2	2.0	2.1	0.1	6.7
1,4-Diethylbenzene	0.2	7.1	7.3	7.2	0.1	2.0
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.5	0.4	0.5	0.1	15.7
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G7 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	2.6	2.8	2.7	0.1	5.2
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	12.4	12.1	12.3	0.2	1.7
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Day 4

TABLE G8: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - LAKEVIEW

Compounds	Aeration Basin - Influent					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean**		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	117.0	83.8	100.4	23.5	23.4
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	1.3	0.5	0.9	0.6	62.9
Chloroform	0.5	3.8	3.0	3.4	0.6	16.6
1,2-Dichloroethane	1.0	NA	0.6	0.3	0.4	141.4
1,1,1-Trichloroethane	0.5	2.7	2.9	2.8	0.1	5.1
Benzene	0.5	0.3	0.5	0.4	0.1	35.4
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	0.2	0.4	0.3	0.1	47.1
Trichloroethylene	0.5	0.4	0.4	0.4	0.0	0.0
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	11.3	9.6	10.5	1.2	11.5
Dibromochloromethane	2.0	NA	0.2	0.1	0.1	141.4
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	1.3	1.0	1.2	0.2	18.4
Ethylbenzene	0.5	0.7	0.8	0.8	0.1	9.4
m,p-xylene	0.5	2.9	3.2	3.1	0.2	7.0
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	1.7	2.0	1.9	0.2	11.5
Cumene	0.2	0.1	0.1	0.1	0.0	0.0
Propylbenzene	0.2	0.3	0.3	0.3	0.0	0.0
3&4-Ethyltoluene	0.2	2.3	2.4	2.4	0.1	3.0
1,3,5-Trimethylbenzene	0.2	1.1	1.2	1.2	0.1	6.1
2-Ethyltoluene	0.2	1.0	1.1	1.1	0.1	6.7
1,2,4-Trimethylbenzene	0.2	3.8	4.3	4.1	0.4	8.7
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.3	1.3	1.3	0.0	0.0
1,2-Dichlorobenzene	0.5	1.3	1.3	1.3	0.0	0.0
1,3-Diethylbenzene	0.2	0.1	0.2	0.2	0.1	47.1
1,4-Diethylbenzene	0.2	0.4	0.5	0.5	0.1	15.7
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	0.2	0.2	0.2	0.0	0.0
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE 68 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	0.4	0.5	0.5	0.1	15.7
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	2.2	2.3	2.3	0.1	3.1
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

*   M.D.L. = minimum detection limit
** Day 4

TABLE G9: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - WATERLOO

Compounds	Aeration Basin - Influent					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean**		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	1.3	0.8	1.1	0.4	33.7
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA
Chloroform	0.5	0.6	0.9	0.8	0.2	28.3
1,2-Dichloroethane	1.0	0.7	0.8	0.8	0.1	9.4
1,1,1-Trichloroethane	0.5	NA	NA	NA	NA	NA
Benzene	0.5	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA
Trichloroethylene	0.5	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	NA	NA	NA	NA	NA
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.3	0.3	0.3	0.0	0.0
Ethylbenzene	0.5	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA	NA	NA
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	NA	NA	NA
Cumene	0.2	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.3	1.2	1.3	0.1	5.7
1,2-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G9 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Day 5

TABLE G10: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - WATERLOO

Compounds	Aeration Basin - Effluent					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean**		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	8.4	6.8	7.6	1.1	14.9
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA
Chloroform	0.5	2.2	1.9	2.1	0.2	10.3
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	NA	NA	NA	NA	NA
Benzene	0.5	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA
Trichloroethylene	0.5	0.3	0.4	0.4	0.1	20.2
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	0.2	0.1	0.2	0.1	47.1
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	1.7	1.6	1.7	0.1	4.3
Ethylbenzene	0.5	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA	NA	NA
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	NA	NA	NA
Cumene	0.2	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.2	1.2	1.2	0.0	0.0
1,2-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G10 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Day 3

TABLE G11: PRECISION TEST DATA FOR WASTEWATER CONCENTRATIONS - WATERLOO

Compounds	Aeration Basin - Effluent					
	WASTEWATER CONCENTRATIONS (ug/L)				Standard Deviation (ug/L)	Coeff. of Variation (%)
	M.D.L.*	Duplicates		Mean**		
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA
Dichloromethane	1.0	2.8	2.7	2.8	0.1	2.6
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA
Chloroform	0.5	0.8	0.7	0.8	0.1	9.4
1,2-Dichloroethane	1.0	0.6	0.6	0.6	0.0	0.0
1,1,1-Trichloroethane	0.5	NA	NA	NA	NA	NA
Benzene	0.5	NA	NA	NA	NA	NA
Tetrachloromethane	0.5	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA
Bromodichloroethane	1.0	NA	NA	NA	NA	NA
Trichloroethylene	0.5	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA
Toluene	0.5	0.2	0.2	0.2	0.0	0.0
Dibromochloromethane	2.0	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	0.3	0.3	0.3	0.0	0.0
Ethylbenzene	0.5	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA	NA	NA
Bromoform	2.0	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	NA	NA	NA
Cumene	0.2	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	1.2	1.1	1.2	0.1	6.1
1,2-Dichlorobenzene	0.5	NA	NA	NA	NA	NA
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA

TABLE G11 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit
** Day 5

TABLE 612: BLANKS - WASTEWATER ANALYSIS

Compounds	Concentration (ug/L)						
	M.D.L.*	Reagent Blanks					Field Blank
1,1-Dichloroethylene	1.0	NA	NA	NA	NA	NA	NA
Dichloromethane	1.0	0.4	0.5	0.6	1.4	0.9	NA
trans-1,2-Dichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	0.5	NA	NA	NA	NA	NA	NA
Chloroform	0.5	NA	NA	NA	NA	NA	1.8
1,2-Dichloroethane	1.0	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	0.5	NA	NA	NA	NA	NA	NA
Benzene	0.5	NA	NA	NA	NA	NA	1.0
Tetrachloromethane	0.5	NA	NA	NA	NA	NA	NA
Dibromomethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	1.0	NA	NA	NA	NA	NA	NA
Bromodichloromethane	1.0	NA	NA	NA	NA	NA	NA
Trichloroethylene	0.5	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	2.0	NA	NA	NA	NA	NA	NA
Toluene	0.5	NA	NA	0.1	NA	NA	NA
Dibromochloromethane	2.0	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	2.0	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.5	NA	NA	NA	NA	NA	NA
Ethylbenzene	0.5	NA	NA	NA	NA	NA	NA
m,p-xylene	0.5	NA	NA	NA	NA	NA	NA
Bromoform	2.0	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	2.0	NA	NA	NA	NA	NA	NA
o-xylene	0.5	NA	NA	NA	NA	NA	NA
Cumene	0.2	NA	NA	NA	NA	NA	NA
Propylbenzene	0.2	NA	NA	NA	NA	NA	NA
3&4-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
2-Ethyltoluene	0.2	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	0.5	NA	NA	NA	NA	NA	NA
1,3-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,4-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
1,2-Diethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	5.0	NA	NA	NA	NA	NA	NA
Chloromethane	5.0	NA	NA	NA	NA	NA	NA
Vinyl Chloride	5.0	NA	NA	NA	NA	NA	NA
Chloroethane	5.0	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	2.0	NA	NA	NA	NA	NA	NA
Bromomethane	2.0	NA	NA	NA	NA	NA	NA
Acrolein	25.0	NA	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	2.0	NA	NA	NA	NA	NA	NA
Acrylonitrile	10.0	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.5	NA	NA	NA	NA	NA	NA
Dichloroacetonitrile	15.0	NA	NA	NA	NA	NA	NA

TABLE 612 (cont.):

1-Bromo-2-Chloroethane	2.0	NA	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA	NA	NA	NA	NA
Chlorobenzene	0.5	NA	NA	NA	NA	NA	NA
Styrene	0.5	NA	NA	NA	NA	NA	NA
Bromobenzene	1.0	NA	NA	NA	NA	NA	NA
Pentchloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	0.2	NA	NA	NA	NA	NA	NA
Hexachloroethane	1.0	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	0.5	NA	NA	NA	NA	NA	NA

* M.D.L. = minimum detection limit

TABLE G13: ANALYSIS OF SPIKED WASTEWATER SAMPLES

Trial#1:

Spiked Level = 51.36 +/- 0.41 ug/L

Compounds	WASTEWATER CONCENTRATIONS (ug/L)		Percent Recovery
	Spiked	Unspiked	
Dichloromethane	202.0	158.0	85.7
Chloroform	56.0	11.9	85.9
1,1,1-Trichloroethane	58.9	30.3	55.7
Toluene	54.5	15.6	75.7
Tetrachloroethylene	35.4	2.5	64.1
Ethylbenzene	26.6	3.6	44.8

Trial#2:

Spiked Level = 51.36 +/- 0.41 ug/L

Compounds	WASTEWATER CONCENTRATIONS (ug/L)		Percent Recovery
	Spiked	Unspiked	
Dichloromethane	137.0	83.8	103.6
Chloroform	31.3	3.0	55.1
1,1,1-Trichloroethane	30.8	2.9	54.3
Toluene	47.6	9.6	74.0
Tetrachloroethylene	34.2	1.0	64.6
Ethylbenzene	25.2	0.8	47.5

Trial#3:

Spiked Level = 51.36 +/- 0.41 ug/L

Compounds	WASTEWATER CONCENTRATIONS (ug/L)		Percent Recovery
	Spiked	Unspiked	
Dichloromethane	57.8	0.8	111.0
Chloroform	47.1	0.9	90.0
1,1,1-Trichloroethane	38.3	0.0	74.6
Toluene	37.1	0.0	72.2
Tetrachloroethylene	31.5	0.3	60.7
Ethylbenzene	34.6	0.0	67.4

TABLE G14: POOLED COEFFICIENTS OF VARIATION - WASTEWATER ANALYSES

Compounds	Wastewater Analyses Pooled Coefficients of Variation*				
	Skyway	Highland Creek	Lakeview	Waterloo	Total Estimate
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	36.9	2.6	14.7	21.7	21.4
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	5.6	41.7	NA	34.2
Chloroform	1.3	15.8	18.6	18.4	16.3
1,2-Dichloroethane	NA	NA	1.0	6.7	5.5
1,1,1-Trichloroethane	14.2	17.5	9.0	NA	12.7
Benzene	NA	20.3	70.8	NA	56.3
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	0.0	NA	0.0
Bromodichloroethane	NA	NA	39.6	NA	39.6
Trichloroethylene	30.0	19.9	11.4	20.3	19.8
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	35.6	19.1	10.7	34.7	24.8
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	47.0	24.9	11.0	2.5	23.7
Ethylbenzene	20.3	0.0	8.8	NA	10.2
m,p-xylene	23.7	4.8	8.8	NA	13.6
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	17.7	5.9	10.0	NA	11.7
Cumene	19.1	0.0	14.7	NA	15.1
Propylbenzene	13.6	0.0	4.5	NA	7.5
3&4-Ethyltoluene**	11.4	12.6	5.9	NA	9.5
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
2-Ethyltoluene	10.7	0.0	5.9	NA	6.8
1,2,4-Trimethylbenzene	9.8	10.0	7.2	NA	8.7
1,3-Dichlorobenzene	NA	NA	0.0	NA	0.0
1,4-Dichlorobenzene	5.9	2.2	8.5	4.8	6.3
1,2-Dichlorobenzene	0.0	0.0	5.1	NA	3.6
1,3-Diethylbenzene	15.8	NA	24.7	NA	23.2
1,4-Diethylbenzene	17.3	0.0	8.0	NA	11.0
1,2-Diethylbenzene	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Trichlorofluoromethane	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Acrolein	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	NA	NA	NA	NA	NA
Acrylonitrile	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.0	150.3	7.9	NA	61.7
Dichloroacetonitrile	NA	NA	NA	NA	NA

TABLE G14 (cont.):

1-Bromo-2-Chloroethane	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Chlorobenzene	NA	34.7	0.0	NA	28.3
Styrene	NA	NA	11.8	NA	11.8
Bromobenzene	NA	NA	NA	NA	NA
Pentchloroethane	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	6.4	6.7	6.7	NA	6.6
Hexachloroethane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA	NA	NA
Total Pooled Estimate	21.5	27.5	19.8	17.9	21.8

* Pooled across all sampling locations; Assumption: samples are from a population with the same CVs where sample means may be different

** Merged with 1,3,5-Trimethylbenzene

TABLE G15: POOLED COEFFICIENTS OF VARIATION - WASTEWATER ANALYSES

Compounds	Wastewater Analyses Pooled Coefficients of Variation*				
	Grit Chamber	Aeration Basin Influent	Aeration Basin Midpoint	Aeration Basin Effluent	Total Estimate
1,1-Dichloroethylene	NA	NA	NA	NA	NA
Dichloromethane	27.5	20.9	2.7	10.7	21.4
trans-1,2-Dichloroethylene	NA	NA	NA	NA	NA
1,1-Dichloroethane	28.2	39.3	NA	NA	34.2
Chloroform	16.7	21.2	0.0	9.9	16.3
1,2-Dichloroethane	1.0	9.4	NA	0.0	5.5
1,1,1-Trichloroethane	11.2	14.5	NA	NA	12.7
Benzene	82.9	26.6	NA	NA	56.3
Tetrachloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	0.0	NA	NA	NA	0.0
Bromodichloroethane	35.8	49.0	NA	NA	39.6
Trichloroethylene	19.3	16.2	28.7	20.3	19.8
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
Toluene	26.1	16.9	11.8	34.7	24.8
Dibromochloromethane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
Tetrachloroethylene	23.2	19.9	49.0	3.0	23.7
Ethylbenzene	12.6	5.5	NA	NA	10.2
m,p-xylene	11.8	5.6	28.7	NA	13.6
Bromoform	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
o-xylene	11.0	8.2	20.3	NA	11.7
Cumene	17.2	0.0	20.3	NA	15.1
Propylbenzene	10.6	0.0	0.0	NA	7.5
3&4-Ethyltoluene**	9.8	10.6	0.0	NA	9.5
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
2-Ethyltoluene	9.0	3.9	0.0	NA	6.8
1,2,4-Trimethylbenzene	9.0	9.6	0.0	NA	8.7
1,3-Dichlorobenzene	0.0	NA	NA	NA	0.0
1,4-Dichlorobenzene	9.5	3.2	NA	4.4	6.3
1,2-Dichlorobenzene	5.1	0.0	0.0	NA	3.6
1,3-Diethylbenzene	8.6	49.0	NA	NA	23.2
1,4-Diethylbenzene	6.9	11.2	20.3	NA	11.0
1,2-Diethylbenzene	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Trichlorofluoromethane	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Acrolein	NA	NA	NA	NA	NA
Trichlorotrifluoroethane	NA	NA	NA	NA	NA
Acrylonitrile	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	7.9	106.3	NA	NA	61.7
Dichloroacetonitrile	NA	NA	NA	NA	NA

TABLE G15 (cont.):

1-Bromo-2-Chloroethane	NA	NA	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Chlorobenzene	0.0	34.7	NA	NA	28.3
Styrene	10.1	15.8	NA	NA	11.8
Bromobenzene	NA	NA	NA	NA	NA
Pentchloroethane	NA	NA	NA	NA	NA
1,2,3-Trimethylbenzene	7.9	5.7	0.0	NA	6.6
Hexachloroethane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA	NA	NA
Total Pooled Estimate	19.8	25.6	18.4	16.6	21.8

* Pooled across all four treatment plants; Assumption: samples are from a population with the same CVs where sample means may be different

** Merged with 1,3,5-Trimethylbenzene